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THE UNIVERSITY OF ALBERTA

CAUSE AND NECESSITY IN ARISTOTLE

by

GLEN R. KOEHN

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled CAUSE AND NECESSITY IN ARISTOTLE submitted by GLEN R. KOEHN in partial fulfillment of the requirements for the degree of MASTER OF ARTS.

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Date September 28, 1987

Abstract

Examination of what Aristotle says about moving *aitiai* leads one to conclude that they are not always causes, although they are things whose mention serves to explain a beginning of motion or rest. The capacity of an artist, for example, is a moving *aitia* which does not seem like a cause. Artistic and natural capacities are introduced by Aristotle as sources of motion in part so that he may avoid non-necessary predications in his science; but he sometimes fails to make it clear whether the necessity he wishes to preserve is a natural necessity in the causal order or the necessity of avoiding contradiction. A proper appreciation of his theory of capacities sheds light on relationships between the four *aitiai*, at the level of the elements as well as at higher levels of explanation. Discussion of these relationships raises the subject of hypothetical necessity, along with some controversial questions of exegesis. Aristotle wishes in spite of his emphasis on necessity to allow for the existence of natural contingency. Certain of his arguments for this conclusion further illustrate the failure to distinguish natural from logical relations.

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Table of Contents

Chapter — Page

I. Introduction 1

II. Explanatory Factors 4

A. *Aitia* and Cause 4

Aitiai 4

Moving Factors 11

Accidents 18

Final Remarks 26

B. Natures as *Aitiai* 27

Natures and Simple Bodies 28

Elements and Homoeomeries 38

Substance and Capacity 45

Essence and Final Factors of Homoeomeries ... 53

Final Factors as Causative 57

Prelude to Necessity: Nature and the Good ... 64

III. Necessity 67

A. A Classification of the Necessary 67

Hypothetical Necessity 67

Compulsion 73

That Which Cannot Be Otherwise 77

B. Natural Necessity 82

Some Clarifications 82

An Account 86

A Disputed Question 92

The Balme Interpretation 96

Objection to Balme 99

Contingency 101

Closing Remarks 105

Bibliography 107

I. Introduction

I have attempted to say in the following pages what Aristotle, philosopher of science and metaphysician, thinks about natural necessity. What conception does he have of such a thing; and what subjects in the world does he believe to be actually necessary in this way? The problem, as might have been expected, turns out to be rather complicated. Trying to solve it leads in turn to a broader question, one which must puzzle many a reader picking up Aristotle for the first time. It can be put roughly this way: Why do Aristotle's scientific theories sound so foreign? By this it is not just meant, of course, that he is sometimes mistaken in his predictions. His language of principles, goals, natures and accidents is very different from our own. He almost never even mentions laws, and we soon discover that trying to translate in a straightforward way his assertions about "causes" leads to nonsense. This is a puzzle about what Aristotle believes he is doing in general when he explains things, and it requires us to think both about his scientific theories and the broader conceptual scheme in which they sit. Thinking about these matters is a useful exercise, for bringing his presuppositions to light helps us to become more conscious of our own. In getting clear about explanations based on natures, for example, we are obliged to ask ourselves what the alternatives are. It is argued in subsequent pages that some of the above-mentioned foreignness is due to Aristotle's treating lightly a

distinction whose exact character is not easy to state: the distinction between causation and entailment. Because of its connection with natural and other types of necessity, the discussion of this distinction brings us back in the final chapter to the subject of contingency in the causal order. I have not attempted to give on my own behalf an analysis of the causal relation: such a project would be too ambitious. Nor have I presumed to say whether and to what extent there really is natural contingency in the world, though I have tried to say something about what we should mean when we talk about it. The greater part of the paper is concerned with exegesis rather than independent theorizing.

Finally, perhaps a few words are in order about my practice of treating all the writings in Aristotle's corpus as the work of a mature philosopher, and without taking into account the likelihood of evolution in his thought.[1] It is not simply due to diffidence about my ability to weigh the philological evidence. Considerable obstacles are encountered by those who set out to reconstruct Aristotle's thought-history. The origins of his works are obscure: the first manuscripts may have been edited by others, and subsequent ones suffer from textual corruption. Worse, if what we have are lecture notes and if the lectures were repeated at various times, he is more than likely to have

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[1] cf. Düring Aristoteles Heidelberg 1966 '...nach meiner Ueberzeugung [ist] eine Arbeitshypothese über die chronologische Abfolge seiner Schriften eine notwendige Voraussetzung für die Einzelinterpretation der Schriften...' p.44; though he grants that any attempt to establish such a chronology is inevitably circular.

made revisions to his own writings. Where these revisions are extensive, determining the evolution of his theories is bound to be a difficult and uncertain business; nor can we assume that inconsistencies always show a development in theory. Some tension will doubtless be due to difficulty in reconciling rival intuitions -- the 'things said' -- or to simple error. These obstacles make it seem unlikely in the first place that any satisfactory ordering or general chronology of Aristotle's work will become available. But further, the attempt to establish a thought-history is in large measure posterior to philosophical criticism, since if we wish to determine chronology in the absence of biographical information we are forced to examine the writings at hand for improvements and inconsistencies. In fact, such an examination is not far removed from what I have actually tried to do. Naturally I do not mean to suggest that a tentative developmental hypothesis is never useful when comparing and interpreting passages. For my own limited purposes, however, it has not seemed necessary.

II. Explanatory Factors

A. *Aitia* and Cause

We may take it for granted that at least some of the things which actually exist in the world are caused to exist. It is sometimes held in addition that if something is caused to exist it exists of necessity, and that the necessity in question is not a logical necessity, of the sort evident (for example) in syllogistic deductions, but a necessity which we might as well call 'physical' or 'natural' necessity. From the above claims it would follow that at least some things exist of physical necessity. What, if anything, does Aristotle have to say about the assertions that make up this argument? Since he nowhere addresses the problem in so bald a form we shall have to do some exegetical detective work if we wish to know, and since Aristotle lived at a time many centuries removed from our own we shall have to take care not to introduce into his writings ideas which never occurred to him and interests that he never shared.

Aitiai

It seems a good idea to proceed by noting what Aristotle's views are on the subject of causal explanation. But straightway we encounter a difficulty. The Greek word traditionally translated in English editions of Aristotle's works as 'cause' is *aitia* or *aition*. As as is often pointed

out, however, this translation makes Aristotle appear to say certain things which sound very odd indeed: for example, that the premisses of a syllogism can be "causes" of its conclusion (e.g. *An. Post.* 71b30; *Phys.* 195a15-18; *Metaph.* 1013a15, 1013b20) or that a thing's essence, the "what it was to be something", may be a "cause" of that thing (e.g. *An. Post.* 94a20; *Phys.* 195a20; *Metaph.* 1013b20-25). Again, a thing's parts would, on this translation, be called "causes" of it (e.g. *Phys.* 195a15-20; *Metaph.* 1013b20-25); and the end that some structures serve would be said to "cause" them in a special way -- e.g. shading fruit is held in *Phys.* II.8 to be an *aitia* of some plant leaves inasmuch as that is the end they serve. Such passages may make us wonder whether 'cause' is not a misleading way to render *aitia* into English, and whether Aristotle might not really be talking about something other than causation when he speaks of *aitiai*.[2] Problems of this sort are well known to readers of Aristotle. One is reminded of the Greek words *eudaimonia*, *philia*, and *psyche* (to list but three) which seem to correspond only approximately to 'happiness', 'friendship', and 'soul', their standard counterparts. An interpreter must decide in these situations how far the author is saying false things about a familiar notion and how far he is

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[2] The question has been discussed by (among others) M. Frede, 'The Original Notion of a Cause' in *Essays on Ancient Philosophy*, University of Minnesota Press, 1987; J. Moravcsik 'Aitia as a Generative Factor' *Dialogue* XIV.4 Dec. 1975; 'Aristotle on Adequate Explanations' *Synthese* 28 1974; G. Vlastos, 'Reasons and Causes in the *Phaedo*' *Phil. Review* July 1969..

saying true things about a less familiar one, one which may not easily be captured by a single English expression. Generally speaking, Aristotle's ancient Greek often makes different distinctions than we would wish to, not least because of differences in theory. Where theories have undergone change, some incommensurability between technical expressions is inevitable, and this often makes it very hard to judge individual statements for truth or falsity.[3]

Our difficulty in interpreting Aristotle's remarks in logic and metaphysics is made even worse by a disconcerting tendency of his: I mean his aptness to shift without warning from talking of expressions in a language to talking about the things those expressions describe or pick out. In the case of causes it is sometimes hard to know how far such shifting is due to his official theories about what it is that explains, and how far it is simply a shorthand way of talking which arises from the lack of handy use-mention conventions. For example, it is argued later on in the *Posterior Analytics* that the middle term (*to meson*) of a scientific demonstration is an *aitia*; and while the

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[3] In the case of *aitia*, the problem of finding a satisfactory translation is not (*pace* Barnes 1972) that modern philosophical usage is based on Hume's discussion of causation. Our difficulty antedates Hume, as is evidenced by the fact that already in Descartes' writings expressions equivalent to 'formal', 'final' and 'material cause' have all but vanished from physical explanation. Frede, *Ibid.*, notes a claim by Sextus Empiricus that philosophers all agree in characterizing an *aitia* as 'that because of which in virtue of its being active the effect comes about' (PH III 14). If this is so -- if philosophical usage had by Sextus' time already restricted the term for 'cause' to active agents -- the problem has an ancient beginning.

expression *to meson* sometimes seems to pick out linguistic formulae (e.g. 99a21), it is often clearly used to pick out the non-linguistic objects described by those formulae, as where he states that an act of aggression can be a middle term (94a5f). The point is that such presumably conscious use-mention slipperiness may be an interfering factor in addition to differences between our ordinary notion of a cause and Aristotle's notion of an *aitia*.[4]

It might be thought that a reading preferable to 'cause' is 'explanation', since Aristotle sometimes glosses the expression 'the *aitia*' as 'the *dia ti*' or 'the *dioti*', i.e. 'the through what' or 'the why' (e.g. *An. Post.* 75a35, 85b28; cf. *Phys.* 198a15); and since we might be inclined to characterize an explanation as an answer to a why-question. If answers are linguistic objects, however, this proposal makes it sound as if *aitiai* are linguistic, which will not always capture his intent either. For, according to Aristotle, objects as decidedly non-linguistic as a sculptor or the bronze of a bronze statue have as much claim to be called *aitiai* as do the premisses of scientific demonstrations, and it is inappropriate to call a particular man or piece of metal 'an explanation'. Strictly speaking the explanation is a story or assertion we offer mentioning such particulars. On all the above grounds, and setting aside for now those considerations of tradition which are so important when producing a standard translation, the rather

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[4] cf. his systematically slippery use of the word *horos* as 'term' in the *Prior Analytics*.

bland expression 'explanatory factor' seems for our purposes better suited than 'cause' as a translation of '*aitia*'. I shall adopt it here in order to preserve the word 'cause' for another use.[5] An explanatory factor for Aristotle is just something whose mention serves to explain something in one way or another, as mentioning premisses may explain a conclusion, or mentioning a skill may explain a statue, or a function the functioning thing.

A second term closely connected in Aristotle's philosophical vocabulary with *aitia* is the term *archē*, which sometimes means 'source' or 'beginning' or 'principle', but which can also carry the sense of 'authority', 'dominion', or 'office'. *Archai* and *aitiai* are discussed respectively in the first two chapters of *Metaphysics* Bk. V, and the position of these chapters hints at the importance of the concepts, relative to each other as well as to the rest of the concepts discussed in Book V. An *aitia* is a kind of *archē*, and according to Bk. V.1 *aitiai* are spoken of or asserted in as many ways as *archai*. We might put the claim in a more usual but not entirely faithful way by saying that the words have a similar number of senses. In *Metaph.* V.1 there are listed, among others, the following sorts of thing which can be called *archai*: that part of something from

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[5] Frede suggests that Plato's *Phaedo* uses the different expressions *hē aitia* and *to aition* to mark an important distinction: *aitia* for propositional items -- reasons or explanations -- on the one hand, and *aition* on the other for entities like the Nous of Anaxagoras, or Socrates' bones and sinews. This manner of usage does not occur in Aristotle, and he employs the expressions pretty much interchangeably.

which one would move first, as for example the beginning of a line or a road; that thing belonging in another (*enhuparchein*) from or out of which the second comes to be, as for example the foundation of a house; that thing not belonging in another, from or out of which the second comes to be -- 'from which motion or change naturally begin'. Again, that at whose will moved things are moved is said to be an *archē* -- here, trying to bring out similarities between different uses of the word, Aristotle mentions as examples oligarchies and monarchies alongside of the arts, especially the architechtonic arts. Finally, those things from which something can first be known are called *archai*, suppositions (*hypotheseis*), for example, being the *archai* of demonstrations. This extract from Aristotle's list of instances includes both linguistic and non-linguistic specimens, and indeed, parents and suppositions are among the examples he uses to illustrate his remarks about *aitiai*. One does not have to seek far to see connections between *archai* and *aitiai*. We often explain by pointing to a source or a beginning, or by stating a rule that subsumes apparently diverse things. At least some *archai*, therefore, are *aitiai*. And all *aitiai* are *archai* if they serve to explain, for they are origins of understanding.

It is further worth remarking that some of the different ways in which *archai* are spoken of are explained using two Greek expressions for 'from': *hothen* (whence, from which, wherefore), and *ek* (from, out of). Both of these

Greek words can be used to assert, besides other relations, a causal relation (cf. 'Where did that come from?') or a logical one (cf. 'What follows from this?').[6] The two relations expressed are sometimes called different forms of dependence. Thus the term *archē* makes easier for Aristotle a certain shifting back and forth from logical to ontological dependence, and from talking of explanations to talking of causes.

Now Aristotle, as is widely known, holds that there are four main types of *aitia*, or explanatory factor: formal, material, moving (efficient), and final. I will say more about each of these later. Among them the efficient, or moving factor comes on the whole closest to taking account of what we should call causal relations. This type of *aitia* is sometimes introduced by means of the word '*ek*' or '*hothen*', where a certain causal dependence seems to be entailed -- that of the motion on the mover or on the mover's motion. Aristotle describes it as 'that from which [*hothen*] the beginning [*archē*] of change or rest arises'.[7] For example, a child is said to come from its father (*ek*), the fight from abusive language (*ek*) (*Metaph.* V.1,24).

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[6] e.g. *hothen* Causal -- 1139a31: choice a cause of action. Logical -- 1284a11: to mark an inference concerning legislation. *ek* Causal -- *Metaph.* V.24: fight comes from abusive language; see esp. *GA* 724a20ff. Logical -- *An. Post.* 73a10: two posits the fewest number from which someone can deduce.

[7] R. Sorabji points out (p. 42) that the simpler phrase '*archē* of change' is applied to other factors besides the moving factor. We shall see in Chapter 2 that natures for Aristotle can be sources of change without strictly being moving factors.

Choice is called the originating factor whence (*hothen*) action comes (*NE* 1139a31). All of these are stock examples of moving factors at work. I say that a relation of causal dependence is here asserted partly because the examples look like clear instances of what one would ordinarily call the causal relation; partly also because Aristotle adds after his father-child illustration in *Phys.* II.3 'and in general what makes [or produces -- *to poioun*] sc. "is the moving source" of what is made and what changes of what is changed' (cf. *GC* 335b28). This is causal language, and there is no reason to suppose Aristotle means anything different by it. Whatever, therefore, causal relations turn out to be in fact, and whatever other theoretical work moving factors may do, they are an attempt to give an account of these relations. Mention of them is to serve the purpose of causal explanation.

Moving Factors

If this is so, we ought to try and say a little more about what Aristotle takes a moving factor to be. The English word 'moves' must, of course, be taken here as a transitive verb: to move is to move something. (Though in general moving factors will themselves be in motion, there is at least one such factor which is motionless, namely the first mover.) *'Kinesis'* or 'motion' serves Aristotle as a general word for change, though it sometimes excludes

coming-to-be and passing-away.[8] We cannot enter much into the subtleties of Aristotle's analysis, but he calls motion in *Phys.* III.1 and *Metaph.* XI.9 'the actuality or fulfilment of the movable *qua* movable'. Given, that is, a single motion from one state to another it will at some time be possible to describe what is in the former state as potentially a thing in the latter state. If someone changes from being unlearned to being learned it will have been possible to describe that person at some point as potentially, but not actually, learned. Motion is neither the initial nor the final state, but something in between, the actuality of the potential (*dunamis*) for the final state *as* potential, that is, the potential in process to fulfilment (257b7).[9] It is necessary to add '*as* potential' or 'movable' in order to distinguish the process from the initial and final states of the motion, that is, the thing before and after its change (cf. *Phys.* 201a29-b15). Suppose it is Socrates who changes from being unlearned to being learned. If one were simply to say 'the actuality of this man', pointing at unlearned Socrates, it would be supposed that the initial state were

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[8] See, e.g. *Phys.* 225a26,32; *Metaph.* XI.11; *DA* 406a12. In passing it can be noted that of the three main types of motion (in the categories of quality, quantity or place) the primary or fundamental type is change with respect to place, that is, locomotion -- *phora* (*Phys.* 208a32, 243a10, 260a28, 265b16; *Cael.* 310b33).

[9] G.B.Kerford emphasizes in an article in the **Encyclopedia of Philosophy** (q.v. 'Aristotle') that, although Aristotle often uses the expressions interchangeably, 'actuality' or *energeia* is a technical term which picks out a process, while a second term 'entelechy' refers primarily to the termination of the process (cf. 1047a30; 1048b5).

meant, and if one were to say 'the actuality of the potentially learned' it would be supposed that the final state were meant, learned Socrates. The motion is neither of these. This 'incomplete fulfilment of the movable' account is intended to cover cases of generation and corruption as well as of the three general kinds of motion proper, which are alteration, increase/decrease, and local motion (*Phys.* 201b14). In *Physics* 202a13, Aristotle adds that motion is in the movable thing (cf. *DA* 426a2ff). Putting what has been said above together then, we can describe a moving factor in Aristotelian jargon as something that actualizes a potential or capacity in a movable thing, and this in one of the four ways mentioned: the actuality of the alterable *as* alterable is the motion of alteration, the actuality of the increasible *as* increasible is increase, that of the movable in place as such is local motion, and so on for generation and corruption.[10]

Aristotle notes that a mover will be capable of acting on an object which has the potential to be moved by it, and he states that it will always become an actual mover whenever it is brought together with its patient in the right manner, place and time (e.g. *Phys.* 255a34-b11; *GA* 740b21ff). (Elsewhere, in e.g. *Metaphysics* IX.5-7, he suggests this holds only for non-rational potentialities: rational ones like the arts depend on desire or choice for

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[10] The puzzles that arise from this account in connection with generation and corruption are among those Aristotle tries to answer in his treatise of that name.

their actuality.) In *De Motu Animalium* I.10 he says:

> Now that which is moved, but whose nature is not to initiate movement, is capable of being passive to an external power [*dunamis*], while that which initiates movement necessarily has a kind of power and force [*dunamin kai ischun*].[11]

The acting and suffering are when actualized the same thing, as an instance of teaching can be the same as an instance of learning, although to teach and to learn differ in definition (202b20). It is significant that Aristotle in a number of other passages calls the capacity or potentiality or power to move a patient *itself* an *archē* of motion, meaning a moving explanatory factor (e.g. *Metaph.* V.12, IX.1; cf. *GA* 740b21ff). That is, sometimes the *dunamis* as well as the thing that has it is called the moving *aitia*. The art of healing, for example, is both a rational capacity in the soul (cf. 1046b2) and a moving *aitia* (1019a15). The non-rational capacity heat also is classed with the art of building in *Metaphysics* IX.1 as a source of motion in other things. The capacity of a thing to be moved by another is an *archē* of its own movement (*Phys.* VIII.4), though it is not a moving explanatory factor as a doctor's or a teacher's *dunamis* is.[12]

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[11] (703a6-9). Revised Oxford Translation, Princeton University Press 1984. Future quotations from Aristotle's writings will unless otherwise noted be taken from or based upon this set of translations.

[12] An art is a productive form of knowledge or reasoning (cf. *NE* VI.4-5). Compare his treatment in *GA* II of the

The theory of capacities is, as we shall see, extremely important for understanding Aristotle's account of moving explanatory factors. It reveals, for example, why he can consistently say in *Posterior Analytics* II.12 in the course of expounding his theory of scientific demonstration that moving factors must exist coevally with what they are to explain (95a36-9). What he is assuming is that a thing is most truly a mover when it is exercising its characteristic capacity. The actuality of a thing's potential to move another thing is coeval with the motion itself: x is learning from someone just so long as he is being taught by him, and the place of shelter is being built just so long as someone is actually building it. It follows that a mover is most truly a moving explanatory factor just when that which it is moving is in motion. *Physics* II.3 does something to confirm this interpretation, for at 195b13-21 Aristotle is to be found making the distinction between potential and actual *aitiai* in the following words:

> The difference is this much, that explanatory factors which are actually at work and particular exist and cease to exist simultaneously with their effect, e.g. this healing person with this being-healed person and that housebuilding man with that being-built house; but this is not always

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[12](cont'd) *dunameis* in the soul which act as moving *aitiai* of an organism's development.

> true of potential explanatory factors -- the house and the housebuilder do not pass away simultaneously.

It is useful to see how Aristotle treats the difference between saying on the one hand that the man who rubbed the patient or the wine he prescribed is the moving factor which explains health, and on the other hand that it is the doctor's capacity for healing together with the patient's capacity for getting better which is explanatory. We might be inclined to stress that whereas the former explanation simply mentions in a common-sense way a cause or part of a cause, the latter can be construed as a necessary truth. To hold that the doctor healed his patient but that he was unable to, is to contradict oneself. Where Aristotle draws attention to the difference, however, he appears to hold that explanations of the latter sort are actually superior to those of the former sort. He notes in *Physics* II.3 that to say Polyclitus is the moving explanatory factor of a statue is only to give an accidental explanation, since being Polyclitus and being a sculptor are accidentally conjoined; but to say that a sculptor or the art of the sculptor is the moving factor is to explain non-accidentally. Again, when urging the necessity of giving the most precise explanation he states that in explaining a house (or perhaps, its coming-to-be) it is better to mention the art of building than a builder or a man. A man builds because he is a builder, but a builder builds in virtue of

(*kata*) the art of building. Builders are just those who tend to produce buildings, and sculptors are those who under normal circumstances will produce statues. Their arts are by definition capacities to build or sculpt. (Both building and sculpting are analogous to doctoring and teaching, and Aristotle shifts from example to example when illustrating his remarks about moving *aitiai*.) Thus Aristotle is committed to the thesis that if, say, a fluteplayer were said to produce a house, then the production would have to be called an accident (cf. *Phys.* 197a15).

We must take it that the connections between the meanings of expressions like 'capacity to build' and 'building' are what recommend these sorts of explanations to Aristotle over others. Naturally, it should not surprise us that he is not satisfied with haphazard ordinary explanations like 'Some doctors build houses', which as they stand are not easy to fit into a systematic classification of experience. For that matter, any modern scientist will want to replace at least some lay descriptions by other ones which, together with general laws, will entail predictions about the behaviour of things. Non-scientific explanations will thus at least sometimes be treated as more or less satisfactory substitutes for something else that does the same job better. Aristotle for his part is not in the *Physics* so much concerned with predicting and manipulating the course of future events as with describing them in a way that makes it possible to understand them. What he wants is

scientific understanding, and he is in flight from merely accidental explanation. Understanding something that is not itself a first principle requires knowing certain explanatory principles or premisses and knowing that given these, the result follows necessarily (*An. Post.* I.2). Aristotle's official view, outlined at length in the *Posterior Analytics*, is that the explanations within a science ought to be able to appear as syllogisms having universal affirmative premisses and conclusions, in which the middle terms are explanatory and the conclusions state facts which are explained. The premisses of these syllogisms are themselves necessary in some way, which means that the conclusions will be too; for from necessary premisses a necessary conclusion follows (e.g. An. Pr. I.15; *An. Post.* I.6).

Accidents

What sort of connection is an accidental connection for Aristotle? He holds that accidents generally involve conjunctions of a kind that obtain neither necessarily nor for the most part (e.g. 1025a14ff). The primary notion of an accident is thus sometimes characterized in part using the notion of necessity (cf. *Top.* 102b6-7). At the beginning of *Metaphysics* V.30 Aristotle gives two examples of accidental happenings. His first instance is a man who finds treasure when digging a hole for a plant. Neither planting nor finding treasure necessarily comes one from the other, nor

are they usually associated. It should be noted that Aristotle cannot be talking of some particular event or events, but must be saying something about any event of a certain type, for it is false to say that an individual, one-time occurrence usually happens in a certain way. The second example is of a musical man who happens to be pale. Here too he is speaking of things of a certain sort rather than some particular man. In both these instances it is strictly not the conjunction, but a thing which is accidentally attached that is called an accident (1025a14). He goes on to say in *Metaphysics* V.30 that whatever attaches to a subject but not because (*dioti*) it is this subject at this time or place will be an accident. (He speaks here as if he also holds the converse of this claim: that if something is an accident, then it does not attach because of the subject.) We saw a moment ago that in the examples he was considering he was not speaking of an actual individual finding, something which could be described in different ways. It cannot be *this* finding of treasure which is an accident, since there is doubtless a because-connection between it and the particular digging, namely a *causal* connection. If Aristotle is talking of causal relations, then he cannot be calling individual events accidents when he says that accidents do not attach because of their subjects. This is consistent with his discussion of Polyclitus the sculptor, for he holds that to call the sculptor the *aitia* of the statue is to explain

non-accidentally, whereas to call Polyclitus the *aitia* is to explain accidentally and thus not to give a definite *aitia*.[13] I will return to this in the final chapter during the discussion of contingency. In any case, since scientific knowledge is the knowledge of necessary connections, Aristotle will maintain that the accidental is not the object of scientific knowledge (*An. Post.* I.6; *Metaph.* VI.2).[14]

Aristotle says more about accidental conjunctions and explanatory factors in the difficult Chapter 4 of *Posterior Analytics* I. A principal aim of that passage is to clarify his use of the expression 'in virtue of itself' or *'per se'*. 'In virtue of itself', 'in itself' or *'per se'* are various ways of rendering the Greek phrase *'kath'hauto'*. The preposition *'kata'* has close ties with explanation, as *Metaph.* V.18 suggests: *that in virtue of which* is there held to be asserted in as many ways as *aitia*. In *An. Post.* I.4 Aristotle says that in one sense of 'in itself' what belongs to something because of (or through) itself belongs in itself, and he adds that what does not belong because of itself is accidental (73b11). The referent of the pronoun 'itself' in 'x belongs to y in itself' is unclear in Greek

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[13] To explain accidentally is to give an indefinite (*aoriston*) *aitia* because there are infinitely many accidental properties. See, e.g. *Metaphysics* V.30, VI.2; *Physics* II.5.

[14] I am ignoring the complicated issue of Aristotle's so-called *per se* accidentals, 'said in another way' (1025a30), which can be treated of in demonstrations. These can hold eternally, and do have definite *aitiai*, but what Aristotle says about them is not decisive for the problem of contingency.

as it is in English: Aristotle seems to take it indifferently as picking out x or y. Since the notion of a thing's belonging because of itself is used in Chapter 4 to explicate belonging *per se* the text does not tell us all we might wish about either relation, but two things are especially worthy of our notice.

First, at least two of the four kinds of 'in virtue of itself' assertion are explicitly said to involve essential predication. Without going far into the thorny details of interpretation, it is fairly clear that x belongs to y in itself if x belongs in the definition of y or y in that of x. These seem to be the primary 'in virtue of itself' relations, since Aristotle speaks only of them in *Posterior Analytics* I.6 when he characterizes the accidental as that which is not *kath'hauto* (75b5ff) and goes on to add that what is accidental is not necessary. Hence the accidental is specified in several closely related ways by Aristotle: as what is not necessary nor usual; as what does not attach because of its subject, and has no definite *aitia*; and as what neither belongs in the definition of its subject nor whose subject belongs in the definition of it. Secondly, the examples used to illustrate things which belong because of themselves and those which belong accidentally are very interesting. The example of accidental predication is 'It lightened when he was walking', where there is neither a causal connection nor any entailment. On the other hand the illustration for 'because of itself' relations is 'Something

dies while being sacrificed'. What strikes one is that this sentence provides both an inferential and a causal connection. 'If x is sacrificed, x will die' is plausibly construed as a necessary truth, but if one were told that x had died as a sacrifice one would also suppose that some sort of causal explanation had been given. The definition of a sacrifice is, we can say, theory-laden, meaning in this case that it presupposes certain claims about causal relations. Theory-laden definitions also make an appearance elsewhere in the *Posterior Analytics*, the most prominent instance being Aristotle's lunar eclipse example, mentioned at I.8,31; II.2,8,12,16 (cf. *Metaph.* 1044b13). At *An. Post.* II.2 he asserts, apparently as a general rule, that to state the what of a thing -- i.e. to state its definition -- is to say why it is.

> What is an eclipse? Privation of light from the moon by the earth's screening. Why is there an eclipse? or Why is the moon eclipsed? Because the light leaves it when the earth screens it.
>
> 90a15-18 (Rev. Oxford Trans.)

Granted this definition (which is after all a very reasonable one) the claim 'Privation of light belongs to all eclipses' is both informative about causal relations and true by stipulation. It is true by stipulation because, roughly speaking, if we took it seriously as a definition

then if there were no privation we would refuse the label 'eclipse'. It is informative because those who propose it assume both that there are such things as eclipses and that the word as so defined will pick out what 'eclipse' has come to usually pick out. There are independent ways of picking out eclipses -- by pointing, for example, or by saying 'those darkenings of the moon' -- and the informativeness of the scientific definition comes from the assumption that *these* are *those*. An important continuity is thus assumed between ordinary and scientific usage, so that although the definition is somehow stipulative it is the sort of helpful definition that one could not produce without some knowledge of astronomers' discourse.[15]

Let us recall our examples of artistic production. To say that a builder builds or a doctor heals or a sculptor sculpts in virtue of his art sounds disconcertingly like the claim that poppies put one to sleep in virtue of their dormitive capacity. In a way the former claims appear even less ambitious than is the latter, inasmuch as artists are on anyone's theory capable of art, whereas the poppy example at least incorporates a more interesting assertion about botany and human behaviour. But if we are taken aback to find such seemingly trifling theorems set forth as very paradigms of physical explanation we had better consider

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[15] Aristotle himself makes some remarks in the *Posterior Analytics* and elsewhere about the relationship between non-scientific and scientific definitions. Sorabji (1980), pp.189-201, summarizes a number of plausible interpretations of these controversial passages.

them further. In the first place it should be mentioned that Aristotle's examples assert or presuppose that there are such things as artists and products of art, that they are the things normally picked out by the expressions he uses, and that the artists play a causal role in the being or coming-to-be of their products. It is additionally held that knowledge or reasoning of some sort is involved in such productions. This does not take us far, but it certainly presupposes some understanding of the world's causal order. Secondly, the explanations that Aristotle mentions are quite general in structure, and in practice will be much more detailed. They are to be unpacked, as it were, in a manner that is most clearly illustrated when he turns to the subject matter of his biological studies. Much of *De Generatione Animalium*, for example, is devoted to analyzing into a series of component capacities the capacity of animals to procreate. The capacity of organisms to reproduce themselves is often compared to an artist's capacity to produce works of art (e.g. in *GA* II.1,4 and 6). In both cases the form of the generated thing pre-exists, in the mind of the craftsman or in the offspring's parents. The parent animals and the artist are defined by their capacities to generate under normal conditions, and this capacity is identified with their possession in the mind, or their own instantiation, of the form of the product or offspring. Thus it can be taken as self-contradictory to assert that an animal which realizes its form fully can fail

to generate in the absence of hindrance, or that there are real artists who can't produce. The talk of capacities allows Aristotle to put his substantive theories about what produces what into a certain canonical language: into assertions whose denial can be construed as self-contradictory. A sketchy illustration of how this works in artistic production is to be found in *Metaphysics* VII.9, where the doctor is said to heal by making certain motions, which in turn produce heat. Heat in the motions gives rise to heat in the patient's body, and this heat '...is either health, or a part of health, or is followed by a part of health or by health itself' (1034a26ff). In this passage, and in certain passages which almost immediately precede it Aristotle is buttressing the claim that health in some sense comes from health, by arguing that an art is a form in the soul (cf. 1034a24) and that from art proceed the things of which the form is in the soul (1032b1). When he says that the form of health or house is in an artist's soul he means that the artist grasps its essence -- that is, knows its definition -- and when he says that the artist reasons to the final step and then makes, he means that there is a series of detailed deductions showing how to produce health or a house. Form and actual moving *aitia* are identified, so there can be a non-accidental (causal and inferential) predication (cf. 1078b28ff).

Final Remarks

Things which come to be by art (*technē*) form an important group in Aristotle's theorizing about change and generation. He sometimes (e.g. *Metaph.* VIII.7, XII.3; *Phys.* II.5) mentions two other main groups: the first, of things that come to be spontaneously; the second, of things which come to be *by nature*. One thing that sets him apart from modern readers, in fact, is the significance he attaches to this threefold classification. Spontaneous generation proper is occasionally further distinguished from generation due to chance (e.g. *Phys.* II.6; *Metaph.* 1070a5-8), both however being characterized as having accidental *aitiai*. Just why spontaneity and chance fail to fit into Aristotle's explanatory framework as full-fledged *aitiai* is a question worth trying to answer, but I would like to turn now to those cases of coming-to-be and of motion generally which are explained by mentioning the nature of a thing. Following this thread will allow us to explore further the relationship of forms, capacities and moving factors, and lead us toward a discussion of natural necessity.

B. Natures as *Aitiai*

In the preceeding chapter I discussed some features of Aristotle's theory of moving *aitiai* or explanatory factors, things whose mention serves to explain the beginning of motion or rest. I recalled his view that accidental connections are not the objects of strict knowledge, and his desire to avoid citing them when doing science. It was noted that a language of capacities actualizing is favored when he gives moving factor explanations, and I suggested that this is in part because it allows him to present certain substantive causal explanations as following from his scientific characterizations of movers. That is, it allows him to couch these explanations as essential, hence non-accidental, predications. One result of such a policy is to make it less clear whether or not the denial of a given explanatory assertion is self-contradictory. To illustrate these points I appealed to some Aristotelian examples of artists or craftsmen, who have by definition the capacity to produce under normal circumstances.

In what is to follow I want to elaborate on the above themes as they appear in Aristotle's theories about coming-to-be in nature. First, I will show how explanations citing active and material factors work at the level of the elements and homogeneous bodies. Later the topic of formal and final explanatory factors will be raised, and something will be said about the relationships between the four factors in the coming-to-be of organisms. An apparent

contrast between material factors on the one hand and formal/final factors on the other broaches the controversial subject of hypothetical and non-hypothetical necessity in nature.

Natures and Simple Bodies

At 302a15 Aristotle explains what an element is, as follows:

> An element, we take it, is a body into which other bodies may be analysed [diaireitai], present in them potentially or in actuality (which of these, is still disputable), and not itself analysable into bodies different in form.

Aristotle holds that there are in the sublunary world four such elements: earth, water, air and fire. There is in addition another element, aether, which exists beyond the moon and which is the matter of the heavenly bodies (*Cael.* I.3). All the elements are natural things; that is, they are things which have an internal *archē* of motion or rest, and this *archē* is said to distinguish them from the products of art *qua* artistic (*Phys.* II.1). Inasmuch as they are simple bodies, the motions that belong to them are simple, the only possible simple motions being towards, away from, and around the center of the finite universe (*Cael.* 268b26; 270b26). It appears that these claims about the movements of the elements follow from their definitions, so that if the

natural tendency of a thing were for it to travel upward, it could be neither pure earth nor pure water. If it naturally moved down it could not be air or fire; nor could it, naturally moving up or naturally down be aether, since aether is just that simple body which naturally moves in a circle (cf. 269a17).

> The term 'according to nature' [*kata physin*] is applied to all these things [sc. 'which have an internal origin of motion or rest'] and also to the attributes which belong to them in virtue of what they are, for instance the property of fire to be carried upwards.
>
> (192b35ff; cf.199b32-3)

It is clear that the elements move *by* or *according to nature*, and that to say so is to mention something, a nature, which is an *archē* of motion and an *aitia*.

Complex bodies have natural motions which depend on the constituent elements of the complex (269a2,29), and living organisms with a common nature have common motions that distinguish them from organisms with different natures. The body of an animal may be in motion unnaturally when the animal grows, say, or when it is walking, though taken as a whole the animal may be in motion naturally (*Phys.* 254b15).[16] In addition to differences between organisms

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[16] In other words, the animal will have natural motions which are in no sense a compound of elementary natural motions, and it will actually move in ways that would be

generally and non-organisms, explaining the motions natural to animals will be more complicated than explaining the motions of other things since some animal motions have their sources in imagination and appetite.

What does it mean to hold that an element's nature is the source or origin of its motion? One is tempted to say in a straightforward manner on Aristotle's behalf that natures taken as origins of motion are *dunameis*; but this is not quite the way he talks. Strictly speaking (1020a5), a *dunamis* is a source of change in another thing, or in the same thing *qua* other (cf. 301b17; 1046b3). That is why arts are cited as paradigmatic examples of *dunameis*: a doctor's *dunamis* is the source of healing in a patient, whether the patient is another person or whether it happens to be the doctor himself. Natures (in one sense) are by contrast just sources of change or motion in a thing *qua* itself (e.g. *Phys.* 192b19; *Metaph.* V.4), so that it is not accidental that mover and moving thing are identical. Nevertheless, Aristotle sometimes uses the word *dunamis* so as to include natures, and indeed, so as to include every source of motion or rest, and he remarks toward the beginning of *Metaphysics* IX.8 that 'nature also is in the same genus as *dunamis* for it is a source of movement' (1049b5ff). It looks, then, as though we ought strictly to speak of capacity as the genus, *dunamis* as the species.

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[16](cont'd) *against* elementary motions. More will be said about this later on.

Aristotle does not think that a subject's having an internal source of motion or rest means that all of its natural motions are completely explained by mentioning the subject. He denies hesitantly in *Physics* VIII.2, and more decisively in *Physics* VIII.6 that motion can come to be in a thing -- animate or inanimate -- without there being some previous or contemporary external motion on which the subject's motion depends for its existence. It is an important project of his in the latter part of the *Physics* to show that a complete explanation of motion requires mention of a first and unmoved mover, which, being prior to later factors, is explanatory in a higher degree than they are. In the case of the simple bodies he makes it clear that their motion is derived from something else (*Phys.* VIII.4), though this is not so obvious in the case of natural motion as it is in the case of motion by constraint (254b25). It is derived, not because external motion must be present to propel the body in some direction, but because the motion is due to that which brought the body into existence and made it light or heavy, or (accidentally) to that which released what was hindering or preventing the motion (*Phys.* 256a1-2; *Cael.* 311a10ff). To say that the elements tend toward their places is in a way self-explanatory, but it is not incompatible in any particular case with causal explanations of the sorts mentioned.

Wondering why a given bit of earth or fire tends to travel in some way may show that one has not fully grasped

its real nature. But Aristotle seems to make another claim as well. He seems to treat it as *self-contradictory* to deny the assertion that earth travels downward and fire up. In *De Caelo* IV, explaining the nature of the sublunary elements and the *aitiai* through which they have their upward or downward capacities, he says:

> Thus to ask why fire moves upward and earth downward is the same as to ask why the healable when moved and changed *qua* healable attains health and not whiteness.
>
> 310b16-19

The reader is asked by Aristotle to imagine someone who, considering an organism as a healable thing, asks why it has become healthy instead of white. We should naturally be tempted to say that the questioner has not understood the meaning of his own utterance. To call a thing 'healable' is to assert that it is capable of being healed -- that it has that capacity and will exercise it if unhindered. Asking why a thing capable of attaining health attains health when it realizes this potential is just to ask: Why, given that there are means to effect health, and they are present, does it grow healthy? The questioner has invited the answer already implied in his question. To go on to mention whiteness is a sign of confusion because whiteness and health are neither one a part of the other's definition. Having questioned a necessary truth -- that a potential for x will produce x if realized -- the speaker has gone on to

ask for an irrelevant explanation.

In the same passage Aristotle describes the relation of a simple body to its natural place of rest as being like that of any motion to its goals (310a20ff). Just as any change proceeds from contrary to contrary or to something intermediate, and not to any chance goal, so an element does not move in any chance direction, but to its own place. Now a contrary together with its opposite contrary and such intermediates as may be, exhausts the range of logical possibilities for a thing in that logical space (cf. *Cat.* 10, 11). Since it is contradictory to say that a thing changes but remains exactly the same, it is necessary on pain of contradiction to agree that if a thing exhibits a contrary and changes with respect to it, the change proceeds to either the opposite contrary or an intermediate. A change just is a proceeding of this sort, and to describe it as a passage from one state to a state which does not necessarily exclude the first is to describe that change in a misleading way. This is something Aristotle is driving at when he says quite generally that a motion is not to any chance goal. As a thing considered *qua* changeable is of necessity potentially in a different state, so a body *qua* element has of necessity the capacity to move to its place. He adds that this motion is toward the body's own form (310a35), meaning in part that a light or heavy thing is not light or heavy in the fullest and strictest sense until it is in its proper place (311a2; cf. *Phys.* 255b11ff). We see, then, that he

explains an element's motion to its place using the analogy of a thing changing from one state to its contrary. In both cases he denies that the change is to a chance, or accidental goal. It is thus tempting to conclude that he holds it a necessary truth that earth naturally travels toward the centre, the denial of which is as absurd as saying a thing could grow but remain exactly the same size.

An element does not engage in motion like an animate thing, though it contains a source of motion within itself. Only organisms that are capable of self-locomotion are said to move themselves, and these contain within themselves both an origin of motion and something distinct (254b30; cf. 255a12ff) that is moved locally by it. It follows that for a thing to move itself is something other than for it simply to have an internal source of motion, and this consequence is made explicit at 255b27-31. The natural capacity that an element has for motion is a passive one: 'not to move something or to produce [*poiein*] motion, but to suffer it' (255b30f).[17] This formulation may seem strange, as virtually any object is able to be moved or changed, and it is hard to see how a merely passive capacity can account for upward and downward motion. Aristotle tries to explain why it is not evident whence elemental motions come by distinguishing types of potentiality (255a30). Water, a heavy element, is potentially light, since it could be changed to air, presumably by the intervention of some external mover; but

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[17] Thus there is no efficient, or moving, factor immediately responsible for such motion except accidentally.

air is potentially light in another way, since in the absence of positive hindrance the activity of lightness -- being in a high place -- will exist. Again (255a33), someone learning is a potential knower in a different way than someone who possesses knowledge but is not actually exercising it. (Aristotle thinks that only while actually exercising knowledge can one be said to know in the fullest sense.) The knower who meets with the right opportunity exercises his knowledge in the absence of hindrance, and if he does not it is a contradiction to call him such (255b5).[18] In this respect his potentiality is like that of a simple body.

We are now in a position to give the following account of what having a natural source (*archē*) of motion amounts to for an element: an element has such a source if and only if without an external propelling mover present it has by definition the ability to move or change in a certain way, and will do so in the absence of hindrance. It is not anticipating ourselves too much to observe that this local motion of a simple body is in Aristotle's scientific theory closely analogous to certain natural changes which take place in biological organisms. For example, the capacity for natural motion which an element has is like the ability to grow, or the capacity of a sick organism to regain health. In each case the object during its motion is properly

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[18] (Given, one assumes, that he chooses to exercise his knowedge.) Using the mixed language of ontology and logic, Aristotle says: 'He would be in the contradictory [state]' *en tē antiphasei*

described for scientific purposes as an imperfect specimen moving toward the fuller instantiation of its species. The only difference, says Aristotle, is that subjects of healing or growth are moved purely from without, wheareas of course elements have an internal origin of change (310b21ff). He immediately qualifies this qualification in turn by remarking that sometimes even growing things or the subjects of healing change of themselves (*ek*), proceeding toward health or increase upon a slight external motion. The reason, according to him, why these less than the elements appear to contain within themselves the origin of their motion is that the matter of the elements is nearest to substance (310b30). This cryptic explanation is not very clearly laid out, but seems to mean in part that locomotion -- an assertion of whose existence follows from the definitions of the simple bodies -- is prior to other motions. If it is prior, in the sense that other motions depend on it, and if elemental matter need only exercise it to fulfil its potentiality, Aristotle probably thought it reasonable to hold both that elemental potency (matter) is closer to actuality than is the healable or growing thing, and that the motion is somehow more self-explanatory.

For our purposes the immediately interesting point is the similarity of explanatory structure at the elemental and complex levels. The fully realized state of a higher organism involves a great many more powers and activities than does the fully realized state of a simple body; but

both organisms and elements alike become actual representatives of their species by first being merely potential representatives which in the absence of hindrance will come to attain their forms. The 'hindrance' clause here, in addition to taking care of cases where opposing forces are present, rules out extraordinary conditions like the lack of air or food which might cause death to organisms and thus prevent them from behaving according to their natures.[19] By way of illustration, take the function of procreation in sexually differentiated organisms. Male and female are defined with reference to their role in reproduction (e.g. 716a13, 728a16, 738b20, 741a15), and the generation of another organism like itself is said to be the function (*to ergon*) of a naturally perfect animal or plant (415a22-b7; 731b6; 735a18). For a thing to perform its *ergon* is for it to achieve its form; for it to achieve its form is for it to realize its nature. Consequently, to call something a potential plant or animal is to assert at least in part that in the absence of constraint or of abnormal conditions it will come to produce offspring like itself. To describe a thing non-accidentally one needs to state its essence -- to state what it is. To state the essence of a natural thing involves saying what its nature is. Now, a thing has a nature either potentially or actually (1015a18), and a juvenile or convalescent specimen has not yet realized its nature completely. To say that it has a potential nature

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[19] See *On Youth and Old Age* Ch. 23 for an account of natural and unnatural death. Also 230a26-28; 288b15.

of some sort is to assert that it has the capacity to become a more or less fully functioning member of the species and will do so if unimpeded. Similarly, to call an element 'fire' is to say in part that it will rise if unimpeded. If it is not at the outer limit it has the nature potentially, and if it is at the outer limit it has the nature of fire actually.

Elements and Homoeomeries

To this point I have spoken only of the elements' local motion; however it is clear that on Aristotle's view they have other important powers in addition to lightness and heaviness. In *De Generatione et Corruptione* II.2-3 he speaks as though the elements ought, *qua* origins of tangible bodies, strictly speaking to be defined by means of the contraries hot-cold and dry-moist.[20] The contraries heavy-light are excluded as origins of tangible bodies because, although they pertain to touch (unlike whiteness-blackness, for example), they are said to be neither active nor susceptible -- that is, things are not called heavy or light because they act on, or suffer action from, other things (329b21).[21] Aristotle wishes by the

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[20] Some translators (e.g. Ogle; see also Peck's 'Introduction' p.lv) render *hugron-xēron* as 'fluid-solid', rather than 'moist-dry'. But as Joachim, in his notes on 329b30-32, objects, fire can scarcely be called solid.

[21] One may well wonder in passing what the connection is between the heaviness or lightness of the sublunary elements and their hotness or dryness. So far as I know Aristotle never clearly explains why it is not an accident that it is just the hot element which tends most toward the limit while the cold one moves to the center. In fact, there is a

character and actions of the elements to explain a great many phenomena, including textures, shapes and temperatures of homogeneous substances, and the heavy-light pair will not allow him to do it (cf.648b3-10). Since opposites cannot combine in a thing, there are said to be four possible unities corresponding to the number of simple bodies: fire is hot and dry, air is hot and moist, water is moist and cold, and earth is cold and dry.[22] Though each of the elements is thus made up of two qualities, each is also simply characterized by a single quality: fire-hot, air-moist, water-cold, earth-dry (e.g. 331a3; 382b2;

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[21](cont'd) conspicuous silence about the matter, not only in *De Caelo* and *De Generatione et Corruptione* but also in *De Anima* II.11, which seems to refer to *GC* II when discussing the objects of touch but avoids mentioning lightness and heaviness. He is surely aware of the problem, since he speaks of theories which try to give a single account of the different powers that an element has (e.g. shape theories in *GC* I.8 and *Cael.* III.8). In *Parts of Animals* II.1 it is claimed that hot, cold, wet and dry make up the material of composite bodies, and that other differences, including heaviness-lightness, are derived from these; but no argument is given. (At 260b8 he appears to countenance the idea that hot-cold, heavy-light and soft-hard are all forms of density and rarity -- but cf. 330b9ff, 646a16ff and 648b10, which make hot-cold and soft-hard prior to dense-rare.) Thus although the elements of bodies *qua* tangible are, in *GC* II.2 stated to be hot-cold and dry-moist, it is not obvious how the apparently posterior qualities heavy-light which are elsewhere held to follow from the natures of the elements are deducible from the primary qualities. On this issue and others relating to the elements see G. A. Seeck *Uber die Elemente*.

[22] The element fire seems not to be quite the same stuff that is generally referred to by the term. In *GC* II.3 Aristotle says that the simple bodies are not identical with earth, air, fire and water, though they are similar in nature to them. 'Thus the simple body corresponding to fire is fire-like, not fire; that which corresponds to air is air-like; and so on with the rest of them' (330b23ff; cf.341b14). Generally, Aristotle speaks as though they were identical, and so shall I.

441b12). The four, says Aristotle, cannot be reduced to one another (330a25), though fine-coarse, viscous-brittle, hard-soft 'and the remaining differences' are derived from these (*ek toutōn eisin* 329b32).

What role do the elements play in the formation of homogeneous substances? The homogeneous bodies, or homoeomeries, are usefully described in *Meteorology* IV.10:[23]

> By homogeneous bodies I mean, for instance, the stuffs that are mined -- gold, copper, silver, tin, iron, stone, and everything else of this kind and the bodies that are extracted from them; also the substances found in animals and plants, for instance, flesh, bones, sinew, skins, viscera, hair, fibres, veins (these are the elements of which the non-homogeneous bodies like the face, a hand, a foot, and everything of that kind are made up), and in plants, wood, bark, leaves, roots, and the rest like them.
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> (388a10-20)

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[23] The authorship of *Meteorologica* IV has been disputed by, among others, W. D. Ross and Werner Jaeger. Jaeger bases his conclusion in part on a paper by I. Hammer-Jensen 'Das sogenannte IV. Buch der Meteorologie des Aristoteles' *Hermes* 50 (1915). The conclusion and the paper are vigorously attacked by Düring in *Aristotle's Chemical Treatise*. For an article which attributes the book in its final form to Theophrastus, and for further references, see H. B. Gottschalk, 'Die Verfasserschaft von "Meteorologica" Buch IV' in *Die Naturphilosophie des Aristoteles*, ed. G. A. Seeck, Darmstadt 1975. The following quotation in any case certainly captures Aristotle's view.

Such bodies are distinguished from each other by qualities like color, fragrance, tension, ductability, fragmentability, hardness and so on (385a1ff). Aristotle says that the elements make up the matter, or parts, of homogeneous bodies, which in turn constitute the matter or parts of non-homogeneous things. In the case of organisms, non-homogeneous bodies form in their turn the parts or matter of the whole organism (389b25; 646a12-b9; 715a7). Thus there are four levels: elements, homoeomeries, non-homogeneous parts, and whole organisms. The part-to-whole relation is not transitive, so that one cannot, for example, in the strict sense call elements the parts (or matter) of organisms. They are so only potentially, inasmuch as they exist at a lower explanatory level and require further analysis to be distinguished.

The elements, then, are, as parts, at the lowest of the four explanatory levels named. Aristotle further characterizes their qualities at 329b24-32:

> But hot and cold and dry and moist are terms, of which the first pair implies power to act and the second pair susceptibility. Hot is that which associates things of the same kind (for dissociating, which people attribute to fire as its function, is associating things of the same class, since its effect is to eliminate what is foreign), while cold is that which brings together,

> i.e. associates, homogeneous and heterogeneous things alike. And moist is that which, being readily adaptable in shape, is not determinable by any limit of its own; while dry is that which is readily determinable by its own limit, but not readily adaptable in shape.
>
> (cf. *Meteor.* IV.1)

In homogeneous bodies the passive qualities dry (i.e. earth) and moist (as it exists in water) constitute the matter, while the agents (*ta poiounta*) are the hot and the cold (384b26; 388a20). Cold is also said to be in a way matter, for it is common to both earth and water (389a20; cf. 382b4). An attentive reader may notice that Aristotle is in a rather uncomfortable position here. On the one hand he has a tidy way of assigning pairs of qualities to his four elements, so that each shares one power with consecutive elements and the powers are not far from what sense experience suggests. It is a powerful, elegant and ingenious theory, which seemed to accomodate the insights of predecessors like Empedocles. To make, for example, the characteristic capacity of water moist instead of cold would wreck the symmetry. It would require changing the essential power of air to either dry, hot or cold, none of which are attractive possibilities. Hot must clearly be taken by fire, and earth's non-adaptability of shape is best explained by its dryness. To make air essentially cold would fail to

allow for the observable enmity between fire and water, as well as introducing further complications. On the other hand, however, there is an inclination, especially (but not solely) evident in *Meteorology* IV, to make water and earth the matter of homogeneous bodies. This is presumably at least in part because it is more plausible to make earth and water the preponderant elements of plants, animals and minerals than to take earth and air as such, even though the passive qualities are said to be dry-moist. (For one thing, water is heavier than air.) Hence we find it suggested at 382a2 and 382b2 that water is representative of the moist as earth is of the dry (cf. 388a22ff). Again, in a revealing passage at *GC* II.8, Aristotle explains that all sublunary bodies contain water because water alone among the simple bodies is readily adaptable in shape, and besides, earth has no power of cohesion without the moist. But the moist and adaptability in shape have in *GC* II.2-3 been associated primarily with air, not water. The embarrassment is perhaps mitigated, though it is not removed, by the observation (made in a somewhat different context) that water and air are more combined than the extremes (331a1). If the intermediate elements are less pure than fire and earth they are perhaps better suited to play both active and passive roles; but it is still odd to think of water *qua* cold acting upon itself *qua* moist.

All four elements are said to be found in every compound in the sublunary world (334b31), and we can gather

that, so far as the homoeomeries are concerned, the elements are both material explanatory factors and origins of motion. That they, or at least some of them, constitute the parts or matter has been sufficiently shown. It should also be evident that some or all of them are agents of change in bodies. To take a single example, consider ripening, which is a species of concoction.[24] Concoction is the 'getting the better of', or the 'mastering' (*kratein*), hence, the 'determining' (*horizein*) of indeterminate matter by heat (cf. 379b33; 380a22, 30). When there is a certain ratio of heat to the passive qualities, or proper matter, of a subject, the subject acquires new properties. These new properties exist in virtue of the compacting, thickening and drying action of the heat. Aristotle calls the process a perfecting, since the end of concoction is often the nature of a thing, in the sense of form or essence. In other cases, a concocted thing realizes some other useful form (379b29).

> It is the proper heat of a thing that sets up this perfecting, though external influences may contribute in some degree to its fulfilment. Baths, for instance, and other things of the kind contribute to the concoction of food, but the primary source is the proper heat of the body.
>
> (379b21-25)

Ripeness in fruit is an instance of the perfecting Aristotle

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[24] *pepsis*. See esp. *Meteor*. IV.2-3. Also 650a1, 668b10, 753a20, 765b20.

speaks of, since when a fruit is ripe its seeds are able to reproduce it, and this is what we generally mean by perfect.[25] When a fruit ripens it turns from an airy to a watery state, and thence to a more earthy state where its juices are no longer thin and cold (cf. 380b11). The heat, then, that masters the watery matter is the proximate agent (cf. 381b9).

Substance and Capacity

To say the elements are agents of change is to pass lightly over certain distinctions. I have not clearly distinguished the element itself from its capacities, for example. The reason for this is that Aristotle does not always clearly do so. When he is speaking carefully he says that the elementary capacities are origins of the elements, and this pretty plainly implies a distinction (e.g. 329b7; 648b10; cf. 324b18; 329a34). The elements as bodies appear to be a union of simple capacities and prime matter. The latter, never existing apart from such unions, is something of a theoretical construct. Concerning the necessity of positing prime matter, and whether Aristotle actually did posit it there has been some scholarly controversy;[26] but in any case it would be difficult to deny that he sometimes treats the capacities and the elements which have them as

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[25] Putrefaction is not merely a further stage of the ripening process, as it involves the destruction of a subject's heat by external heat. Cf. 777a11.

[26] See Charlton's Appendix for some arguments against prime matter in Aristotle and for some references.

non-identical. The capacities are qualities (*pathē*) or properties (*idia*) of the elements, and a thing is not a quality or property of itself. Yet when explaining changes, Aristotle says indifferently that the capacities are responsible and that the simple bodies are. Both ways of speaking are natural, even in English, and the shift is made easier in Greek by the frequent nominalization of third person neuter adjectives, which are systematically ambiguous as between a universal and an object which instantiates it (e.g. *to thermon*). We have already noticed in the realm of human action a conscious movement on Aristotle's part between saying that the artist produces and that a certain affection of the artist -- his art -- does the producing. This movement is repeated in the discussion of elements. An example of it appears in *De Generatione et Corruptione* I.7. Here Aristotle has set out to explain 'why fire heats and the cold cools, and generally why the active thing makes itself like the patient' (324a9). It is noteworthy that in this very sentence fire is placed in opposition to the cold as though they were on a level. 'The cold' (*to psychron*) does not always pick out the simple body water, but sometimes instead the capacity that is contrary to hot. Such an interpretation is supported by what Aristotle has said a few sentences earlier:

> For unless two things either are, or are composed of, contraries, neither drives each other out of its natural condition. But

> since only those things which either involve a contrariety or are contraries -- and not any things selected at random -- are such as to suffer action and to act, agent and patient must be like (i.e. identical) in kind and yet unlike (i.e. contrary) in species.
>
> (323b28-33)

The main point here is that acting and suffering must be described in such a way as to reveal the real structure of the process, so that one may resolve the conflicts and seeming conflicts of previous thinkers. What is of especial interest to us, though, is that contraries (like white or black, hot or cold) together with the things they compose (including, one assumes, fire or water) are all spoken of as if they were agents. Here, as often elsewhere, Aristotle's interest lies in distinguishing accidental from canonical scientific explanations; and he is not particularly worried about lumping together things as different as bodies and their powers.[27] He is doubtless encouraged in this tendency by his belief that contraries never exist separately from

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[27] Compare 335a3-9, where simple bodies are said to be contraries, though Aristotle adds '...in so far as one substance can be contrary to another'.
Compare also 646a13-17: 'Now there are three degrees of composition; and of these the first in order, as all will allow, is composition out of what some call the elements, such as earth, air, water, fire. Perhaps, however, it would be better to say composition out of the capacities...for wet and dry, hot and cold form the material of all composite bodies.'
And compare 736b35: 'This is not fire nor any such *dunamis*.'

bodies anyway, and that the simple bodies are defined by them. Besides, granted that a moving *aitia* is just something whose mention serves to explain the beginning of motion, and granted that mentioning either the body or its power can serve to explain, it would follow that both can be truly called moving *aitiai*. Thus Aristotle actually has a quasi-theoretical justification for ignoring the distinction.

These ways of speaking are not peculiar to Aristotle. A. L. Peck, tracing in his Introduction to *De Generatione Animalium* various uses of the term *dunamis* (see pp. xlix-lv), observes that in some pre-Aristotelian medical treatises *dunameis* were substances which had a specific character, elemental constituents of the body and its foods.[28] He emphasizes that the *dunameis* were not thought to be substances which had powers; rather they were both substances *and* powers -- though he does not explain how this could be possible. It is also interesting to notice certain equivocal uses of the term *dunamis* in some Platonic dialogues, though I am not confident that the equivocation plays any important role. In the *Protagoras* creation myth, for example, we find such things as hair, skin, largeness and smallness referred to as *dunameis* (320-321); in the *Ion* (533), a magnet and alternately its *dunamis* are said by

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[28] pp.xlix-lv. Peck mentions the Hippocratic treatise *The Ancient and Genuine Art of Medicine*; also the physician Alcmaeon of Croton. I am not persuaded that all the texts Peck cites with reference to *dunameis* will bear his interpretations.

Socrates to draw other objects.[29] Finally, the *Timaeus*, which generally distinguishes between the elemental bodies and their *dunameis*, says at 62b that the name 'cold' is given both to an affection (*pathos*) and the producing agent (*to drōn*). Elsewhere in Aristotle's corpus too, *dunamis* is used to refer to substances which have a power, rather than to the power itself (e.g. 720b32; 736a20).

It is easy to point out careless usage in Aristotle, but risky to argue that the carelessness shows real error in his thought. To confuse a body with its powers would seem a shockingly crude category mistake; and yet I am persuaded that the identification, made in part via the protean term *dunamis*, had an important influence on Aristotle's thinking about causal relations. In particular, by allowing him to put what we should call causal explanations into his capacity language it enables him to reduce certain causal claims to necessary truths and so helps to prevent him from making a distinction between logical or inferential necessity on the one hand, and physical necessity on the other.[30]

Imagine a chemist placing two substances together and observing a reaction. He explains that substance A reacts to substance B in such and such a way inasmuch as the former is

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[29] These references due to G. Prauss, *Platon und der logische Eleatismus* pp.71-72. With them cf. *Timaeus* 45e.

[30] That Aristotle makes no clear distinction between logical or conceptual and physical necessity is, of course, a widely held view. See, for example, Hintikka, Remes, and Knuuttila, *Aristotle on Modality and Determinism*, Sections 10, 35, 44; also Sorabji, 'Aristotle and Oxford Philosophy', *American Philosophical Quarterly* 6, 1969.

an acid, the latter a base. There will a set of underlying laws concerning molecular structures and their interactions which, taken together with claims that A is acidic and B basic, predict that the observed reaction will occur under given circumstances. These laws will be to some extent independent of the definitions of acidity and baseness; that is, they could in principle be modified without rejecting the descriptions 'acidic' and 'basic' if the expected reactions between substances like these repeatedly failed to occur. It is true that in practice, faced with recalcitrant experimental data the chemist might eventually wish to reject the notions of acidity and baseness as unhelpful, and replace them with different concepts, much as the notion of natural places has been discarded in twentieth century physics. This is perhaps especially so insofar as 'acidity' and 'baseness' are technical expressions with a considerable amount of chemical theory presupposed in their definitions. Nevertheless, it would be possible to modify the laws without rejecting the descriptions, and it could not be said that to deny the capacity of an acid to react with a base is to contradict oneself. Definitions that incorporate less theory, or more firmly held theory, are less likely to be rejected, and the expressions associated with their definitions are less likely to be abandoned.

Consider, in the light of this, a passage in *De Sensu* that speaks of the elements:

> For, like all things else, the moist is

> affected only by its contrary; and this contrary is the dry. Thus we see why the moist is affected by fire, which, as a natural substance, is dry. Heat is, however, proper to [*idion tou*] fire, as dryness is to earth, according to what has been said in our treatise on the elements. Fire and earth, therefore, taken absolutely *qua* fire and earth cannot naturally act or be affected; nor any other pair. Any two things can act on or be affected by one another only so far as contrariety resides in either.
>
> (441b8-15)

This explanation can be interpreted as a physical explanation citing causal factors, and it is put forward in the context of explaining savors in pericarpal fruits. But to say that the moist is (strictly) affected only by the dry is in some ways very unlike the acid-base explanation. I do not mean to claim that it must be an unhelpful thing to say. Since Aristotle has independent ways of picking out moist and dry elements the principle fits into his wider physical theory. Yet at the same time, because these elements are identified with contrary capacities, the assertion that one can exist only in the other's absence and that a thing which moistens must moisten an object with the contrary quality is not a straightforward claim about causal relations.

Aristotle by means of his equivocation on 'capacity' can move from the first to the second of the following two claims:

a) A thing dried is moved in virtue of a drying capacity.

b) A thing dried is moved in virtue of a dry element. (This element is fire.)

'a)' can be interpreted as saying something that is necessary on logical or metaphysical grounds, but 'b)' is good old Aristotelian chemistry. Again, consider the assertions:

c) Insofar as a thing on the moist-dry scale moves away from moisture, it moves towards dryness.

d) Contact with more of the same substance doesn't alter a pure substance.

'c)' and 'd)' may not be such that it is contradictory to deny them, but they are highly abstract principles of chemistry. Aristotle just does not always clearly distinguish these levels of discourse. He travels freely from logic and metaphysics to high level chemistry right on down to the region of pericarpal fruits and back again. And my point is that this helped to prevent him from making a distinction between types of necessity.

Essence and Final Factors of Homoeomeries

Granted that Aristotle's elements are both matter and agents of change in the bodies they compose, what are we to say about his other two types of *aitia*, formal and final, when trying to understand homoeomeries? The formal explanatory factor of a thing which comes to be is identified by Aristotle variously: sometimes as the account (*logos*) of the thing's essence (e.g. 194b27; 983a29) and sometimes as the essence itself (e.g. 94a21; 983a28). From this we may infer that if air has come to be out of water, to mention the characteristic capacities of air would be to give its formal *aitia*. In concretion, for example, the moving factor is distinguished from the formal inasmuch as the mover is an agent, while the formal factor is said to be the quality brought about in the process (382a28). This process, and dispersal, drying and moistening, may result in the generation of homogeneous bodies which by nature are not differentiated in virtue of their shapes (*schēmata*; cf. 640b27), but only by qualities which result from the mixture of the elements. 'They are what they are in virtue of a certain capacity of action or passion', says Aristotle (390a17f; 385a1ff), speaking both of elements and homoeomeries. These capacities are a function of the ratio (*logos*) of elements forming a homoeomery (378b28-379a1), and the ratio, which allows one who knows the behaviour of the elements to infer the capacities, is thus also also sometimes said to constitute the formal *aition* of a

homoeomery (cf. 993a17f).

We can see in his discussion of homoeomeries some interesting features of Aristotle's natural philosophy. His theory of elements and ratios allows him to give, of the processes that form some compounds under certain circumstances, explanations which do not mention the product's definition. When agents and matter are present in the right situation and combine in the right proportion, the agents are able to form homoeomeries. There is no need to say that they act for the sake of the product, as we have a sufficient explanation if we mention their own natures and the circumstances they are in.[31] Aristotle does not do much to quantify the ratios involved, but if the essence just is a ratio, it can be interpreted as a necessary truth to say that elements coming together in this situation will combine to form a certain homoeomery. Of the forming process, in which elements coming together act one on another to produce a *synthesis*, he will say,[32] '...that which can be hot must be hot, provided the heating agent is there, i.e. comes near' (324b 7-9). This is reminiscent of *Metaphysics* IX.5, where in the middle of a general discussion of the capacities that move things (*kinein*) we find him saying:

> As regards capacities [*dunameis*] of the

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[31] Jaeger (p. 386) argues that *Meteorology* IV is transitional between Aristotle's teleological physics and a 'Democritean' chemistry. I do not think we are obliged to follow him in this conjecture. Study of *De Generatione et Corruptione* will show a similar non-teleological emphasis at the elementary level.

[32] He is referring to the action of the body on food or wine which produces flesh and health. cf. 322a10-13

> latter [i.e. non-rational] kind, when the agent and patient meet in the way appropriate to the capacity in question the one must act and the other be acted on.
>
> (1048a5-8; cf. 255a34-b11)

Does the 'must' in these passages reveal the necessity of avoiding self-contradiction, or the physical impossibility of avoiding change? Aristotle does not tell us; the presumption is that he does not recognize the distinction. Thus there is a temptation for him to hold that some comings-to-be in the sublunary world occur, not (or not merely) in order that an end may be accomplished, but just of necessity, where the exact nature of the necessity is not specified.

On the other hand, his desire to explain using the concept of an end or goal -- a final explanatory factor -- makes itself felt even at this level of elements and homoeomeries. For as we noticed earlier, he wants not only to say that a homoeomery is elements combined according to a ratio, but also that it is a body with certain characteristic capacities. The exercise of these capacities is its function (*ergon*) or end, and Aristotle holds that function always determines the essence of a thing (*Meteor.* 390a10; cf. *Pol.* 1253a22ff). If the thing fails to perform its function by exercising the capacities it is not a perfect or natural specimen of its kind. According to Aristotle, for something to realize its nature in this way

is for it to achieve a good (cf. *Phys.* 246a13-17). In its natural state it will be a good or well-formed or perfect individual of its type. The good that is brought about is the final explanatory factor, or the end of a thing; and since homoeomeries as well as elements can be good or perfect in this way, they have a final explanatory factor.

There is no requirement that a final *aitia* exist for each non-accidental thing. Aristotle leaves it an open question in *Metaphysics* VIII.4 whether eclipses have such an explanatory factor. He is conscious that talk about goods and ends becomes more strained in the case of lower-level substances, suggesting in *Meteorology* IV.12 that while water, fire, flesh and viscera are for the sake of something, face and hands are more so (*mallon*; 390a9). Specifying the proper functions or ends of elements and homogeneous bodies is difficult, since 'the end (*hou heneka*) is least obvious there where matter predominates most' (390a3-4). What a thing is may be determined by its function, but it is hard to tell when the homoeomeries are failing to perform their functions. That the ends are present to a lesser degree and harder to state helps explain why Aristotle seldom speaks elsewhere of the *erga* of elements and of (especially non-organic) homoeomeries.[33]

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[33] Compare 321b29-32: 'For there [in the non-homoeomerous parts like the hand] that the matter is different than the form is more manifest than in flesh and the homoeomeries'. In *Cael.* 298a28,32 he speaks of substances, including simple bodies, as having affections and *erga*.
Another reason why he seldom speaks of final explanatory factors in the elements and non-organic homoeomeries is, as we shall see, that they play no role as agents.

Nevertheless, if we take seriously what is said in this chapter and in *De Caelo* concerning heavy and light, there are in a way functions/ends of both simple and homogeneous bodies which must be identified with their formal/final explanatory factors. This is consistent with *Meteorology* IV.5, where he asserts that concretion and dispersal, drying and moistening have formal as well as agent explanations in addition to material ones. If the final *aitia* is not spoken of, that is for the reasons mentioned: as a good, it is harder to discern and present to a lesser degree at this level.

Final Factors as Causative

Now although Aristotle says nothing explicit about it, and could not well do so given that he is wedded to a theoretical framework which does not have an exact notion of cause, what strikes one is that sometimes he speaks as if material/agent factors are enough for a *causal* explanation of why an end comes about. This seems to be so in some cases where non-organic, non-artistic things are concerned. Mentioning the form and function of smoke, say, is necessary to understand (and hence to *explain*) it, but in describing the process that will produce smoke from wood and fire, smoke's form and function need not be spoken of. What I mean to say is that in the case of elements and non-organic homoeomeries, formal and final *aitiai* do not act as *causes* for Aristotle, even if he does not clearly state that fact

himself.

A comparison with the organic compounds flesh and sinew is enlightening here. These function as parts of living organisms; if the organism dies they can no longer be called flesh or sinew except homonymously (e.g. 734b25f). Flesh is not just elements in a certain combination, but elements in a certain combination which is in turn part of an animal that can perceive and grow. Qualities like hardness, softness and brittleness, as Aristotle explicitly says at 734b31ff, are not enough to fully characterize flesh; it follows that, contrary to the impression which might be gained from 390b2-9, heat and cold and their combined motions are not sufficient to form parts like flesh which are asserted in the strict sense. Their natures do not provide a causal explanation for the existence of flesh. If they came together by chance to form a whole body that body would still not have the nature or life of an animal; neither therefore can they form part of an animal. The elements composing a hand do not change their ratio at the moment of death. The ratio remains the same, but the capacities of the hand change; so the hand cannot be due solely to the ratio. The homogeneous parts of organisms thus seem to be importantly different from other homoeomeries in a way not fully brought out in *Meteorology* IV, or in *De Generatione*, for that matter (cf. *GC* II.7). This shows that formal/final and material/moving factor explanations are not always different ways of explaining the same thing, even at

the level of homogeneous bodies, but that the former must sometimes be introduced as causes to explain effects that the latter just cannot account for. The point is not just that a final factor is needed to explain why the right proportion of elements is present in some instance to form flesh, but rather that even given the right proportion there is no sufficient cause able to produce flesh without a further nature or other capacity that plays a producing role.[34]

The causal role that final factors play is clearer in the production of non-homoeomerous parts like the face and hands. These are characterized by their shapes as well as their functions and matter, and it it seemed perfectly obvious to Aristotle that elemental motions would not regularly produce such shapes without something to guide them. Left to themselves, the elements will not organize. Therefore he often speaks of nature as being like a craftsman who uses the elements as tools or instruments.[35] The analogy is not just a metaphor, or an 'as though' manner of speaking. Aristotle believes that, just as the capacities which are arts act as sources of movement in the creation of artifacts, so the capacities which are natures act as sources of movement in the coming-to-be of organic things.

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[34] J. M. Cooper, in his paper 'Aristotle on Natural Teleology' makes a similar point: 'When Aristotle opposes the reduction of teleological explanation to mechanical-efficient causation he is opposing ontological reduction just as much as methodological (and theory) reduction (p. 216n10).

[35] Among other references: *GC* 335b29-336a14; *Meteor.* 390b9-14; *PA* 641a8-17,b12-18; *GA* 734b27ff, 789b7ff.

In the domain of artifice, bodies analogous to non-homogeneous parts of organisms are objects like saws, bowls and boxes (cf. 390b11). Here arts, as opposed to natures, are the origins which need to be introduced as explanatory factors at the higher level. The higher capacities can overrule and guide their material, as an artisan can pile up bricks that would otherwise move down. Likewise the soul holds together in one body the earth and fire which tend to travel in opposite directions (*DA* 416a6-10).[36] 'To override' would give the wrong impression if it suggested compulsion; for nothing is more natural than the higher natures at work.[37]

If we concede, as I think we must, that Aristotle is working his way toward causal explanations of phenomena, then it will appear a natural consequence that natures play

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[36] Compare M. Nussbaum's treatment of this *De Anima* passage in her essay 'Aristotle on Teleological Explanation' in the commentary on *De Motu Animalium*, pp. 76-80. Nussbaum fails to emphasize enough the causal work that natures do for Aristotle. It is not Aristotle's view that material/efficient factors and final factors offer alternative explanations, but that the teleological account is '...superior in generality and predictive power' (p. 79). Without natures there would be no cause able to (regularly) produce plants and animals.

I should say, however, that it is not easy to know how much of Nussbaum's paper expresses her own views of teleology and how much she wishes to attribute to Aristotle. Her interesting essay takes the form of a dialogue between a semi-fictional character named 'Aristotle' and another named 'Democritus'. Since her Aristotle relies at times a good deal upon Hilary Putnam and other moderns, the effect is to fuse together exegesis and criticism into an inseparable whole.

[37] As Sarah Waterlow points out (p. 86n37), the elements are present only potentially in an organism. Of course this still leaves Aristotle with the problem of explaining why animals fall, given that they are not actually composed of earth.

in part a causal role. Since he does not have a notion which exactly matches that of cause he does not say so clearly, and yet he would have had to agree if another had said it. A modern philosopher of science who reads Aristotle will come across sentences like the following one: 'There is the *aitia* for the sake of which and the *aitia* whence the beginning of motion comes' (639b12-13). He may be tempted to suppose that he is meeting a familiar distinction, one between functional explanation and mechanical causation. This would, however, be anachronistic. For firstly, Aristotle's material and moving factors are not straightforward causes; and secondly, his final factors do some of the work we would expect a cause to do. That is why Aristotle can hold that final and moving factors often coincide, a claim that is on the face of it rather puzzling. The soul, for example, or some part of it, is both a moving *aitia* and the goal of an organism's development, in addition to being the organism's form (cf. *DA* 415b7-29). At *De Partibus Animalium* 641a23-32 he says:

> And it will be for him [sc.the natural scientist] to say what a soul or this part of a soul is; and to discuss the attributes that attach to this essential character, especially as nature is spoken of -- and is -- twofold, as matter and as *ousia*; nature as *ousia* including both the mover and the end. And such, in the animal, is either its whole soul or some part of it. So in this

> way the natural scientist will actually have to speak more about the soul than about the matter, in proportion as it is more due to soul that the matter is nature than the other way around. For the wood too is bed and stool inasmuch as it is potentially these.
>
> (After Ogle and Balme)

It was noted above that the form and end of a thing can be identical, since the thing's function enters into its definition, and a thing is most truly itself when it has achieved the state that is the good for it -- that is, when it is a good or perfect specimen of its kind and has realized its nature. But how can a form/telos/nature be a moving factor and play a causal role in the growth of a juvenile organism, the development of its parts, when the organism does not actually have the nature yet? The answer is, that nature, like being generally, can be asserted either potentially or actually (1015a18). The (potential) nature of an infant organism is its capacity to grow to adulthood under certain ordinary circumstances.[38] It may seem as though this doctrine makes what is actual causally dependent upon the merely possible. Aristotle will reply that actuality is prior to the potential or capable (1049b5). He holds it a property of substance that in the

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[38] Cf. *Metaph.* 1034a34-b1: 'And things which are formed by nature are in the same case as these products of art. For the seed produces them as the artist produces the works of art; for it has the form potentially.'

production of any substance there must exist beforehand another actual substance -- e.g. an animal if an animal is produced. His answer to the objection is that actual things in nature and art alike are produced by other actuals of the same species via potentials.[39] He makes the theory behind this explicit in *Metaphysics* IX.8, for example. The actual member of a species is prior in formula, in time and in *ousia* to potential members. Actuality is also prior to every origin of change (1051a4), just as eternal things, in which reside no capacities for destruction, are prior to perishables. Thus the objection that Aristotle's teleology makes effect prior to cause is one he replied to.

A second objection to this theory of capacities has been discussed in Chapter 1: that explanation by capacity is tautologous and hence hinders the course of science. That it did serve to obscure certain distinctions to Aristotle is a claim I have tried to argue for. He considered the necessary form a virtue, as it allowed him to avoid accidental predication in his demonstrations; but such a form makes it difficult to tell whether a given consequence is logical or causal. Additionally, in the field of biology it may have helped prevent him from seeing that there is no fundamental causal gap between elementary substances and organic

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[39] Cf. e.g. 202a9-12; 734a29-32,b19-22; 1034b17. An apparent exception is the coming-to-be of spontaneously generated creatures of whose origin there is no scientific knowledge. These, says Aristotle, are things whose matter can be moved even by itself (*huph'autês*) in the way the seed usually moves it -- but he hastens to add that all the others must have parents (*Metaph.* VII.9).

substances Explanations having such a form can be informative insofar as they incorporate substantial scientific theories. Saying that *this* animal is produced by something with a capacity to produce it presupposes that there are animals, and that *this* is one, suppositions which are by no means trivial. Inquiry is not blocked, because a capacity can always be further specified and analysed into more fundamental capacities.[40] For example, the capacity to grow could in principle be analysable into the capacities to take in nourishment, to process it in certain ways and to convert the energy into greater size. These capacities will be parts of the soul. Obviously, this is the sort of theorizing Aristotle actually did.

Prelude to Necessity: Nature and the Good

Up to this point I have tried to show that when Aristotle looks for non-accidental explanations he does not always decide whether he is looking for necessary truths, or for truths which express some sort of necessary causal relation. This may lead one to wonder what he says elsewhere about necessity in the natural order, including necessity in the coming-to-be of living things.

Aristotle did not grasp the Darwinian principles of variation and natural selection. He took it as a simple fact

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[40] See also Alan Gotthelf's article in *The Review of Metaphysics*. Gotthelf's interpretation of the passages on final *aitiai* is similar to the one sketched above, and I am in complete agreement with the general thrust of his paper as summarized on pp. 235-6.

that organisms tend to achieve a mature state in which they are well adapted to survive, and that their parts are such as to serve desirable ends. Roughly speaking his typical method is therefore to explain the presence of an organ or other part by showing how it serves these ends, how it would not do so if it differed in various ways, and how its functions are analogous to those of parts in other animals. Method of this sort, though it has its limitations, was well in advance of what was employed by his contemporaries, and conjoined with Aristotle's often painstaking collection of observations and his subtle and flexible theorizing, was capable of great explanatory power. That there are a great number of different capacities in the world to produce specific forms is thus assumed as a matter of course; but each of these is a capacity to produce some good.[41] A typical statement is that 'in all things the good is in the highest degree an *archē*' (1075a37f). The dependence between Aristotle's ethics and his (other) natural science is two-way, and it is an oft-repeated remark of his that God and nature do nothing in vain. As John Cooper stresses in the above-cited paper, his teleology extends not only to

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[41] Aristotle sometimes seems to make a suspicious move from the claim (a) For a being to realize its form is for it to be a good being of its type, to (b) For a being to realize its form is a good thing for it. See his argument in the *Nicomachean Ethics* that happiness, the good for and function of humans, is activity of soul in accordance with human excellence (*NE* I.7). At *NE* 1178b5ff he argues that '...that which is proper to each thing is by nature best and most pleasant for each thing'. Since the employment of theoretical intelligence is by nature proper to man, it turns out to be the best and most pleasant thing for him as well.

biological phenomena, but to all parts of natural world. Thus there is an emphasis in the works on natural philosophy upon hypothetical necessity: roughly, the necessity of a thing given that some good exists or is to be brought about. In fact Aristotle will say that hypothetical necessity is manifested in everything that is generated as in everything that is produced by art (639b24-5). In the remaining pages I will discuss (by no means exhaustively) natural, hypothetical and other types of necessity, with the object of shedding some little light on Aristotle's explanatory framework and our own.

III. Necessity

A. A Classification of the Necessary

In the final chapter, entitled 'Natural Necessity', I will try to show how Aristotle's theories about accidents and explanatory factors led him to some conclusions about natural contingency in the world of generation and corruption. But before doing so I think it will be useful to consider a passage in Aristotle's works which gives a general classification of the necessary (*to anankaion*). I am referring to *Metaphysics* V.5. Broadly speaking, this chapter reports three ways that necessity is asserted: there is hypothetical necessity, the necessity of compulsion, and unqualified necessity. Aristotle will argue that the last of these ways is prior to the other two, and he will conclude by claiming that simple things are necessary in the strictest sense, and that nothing can attach to an eternally unmovable object which is contrary to its nature. I want to examine *Metaphysics* V.5 and compare its contents with other relevant passages in order to sketch a map of the conceptual neighborhood in which Aristotle's natural necessity works.

Hypothetical Necessity

The first case of the necessary noted in *Metaphysics* V.5 is the case of those things 'without which as a *sunaition*' life is not possible. Aristotle gives as examples respiration and food, necessary for the existence of an

animal. A *sunaition* here seems to a contributing factor; the expression is not common in the corpus, and elsewhere is usually reserved for things contributing to moving or material explanatory factors as joint-factors or conditions. Aristotle's examples of breathing and food suggest that both activities and substances can be *sunaitia*. He now proceeds directly to describe a second way in which necessity is said; one which seems to include the first as special case. It is said by him that we call necessary the things without which good cannot be or come to be, or without which we cannot get rid of or be freed of evil. The instances he mentions are actions: drinking medicine may be necessary in order to be cured, and sailing to Aegina necessary to collect money. I say that this second kind of necessity seems to include the first as a special case because Aristotle surely thinks that life is a good, and that anything necessary for life is necessary for a good to exist. Given that this is so, that the first sort of necessity is subsumed by the second, it may strike one as odd that he should fail to mention the fact. Probably he would say in reply that things necessary for life itself are called necessary in a stricter way than things required for some smaller good. When explaining the parts of animals he makes a similar distinction, saying that certain parts are necessary for an animal's existence and that others are merely there for the better (cf. 640a33-b4). He says this although the lesser good may necessarily depend on these

other parts for its own being.

Aristotle sometimes elsewhere calls necessity of both sorts *hypothetical necessity*, since the necessary thing is manifestly necessary for some posited end. In the lecture *De Somno* (455b26ff) he says of sleep that it belongs of necessity to each animal, and continues:

> I mean hypothetical necessity, such that (a) if an animal is to be, having its own nature, of necessity certain things must belong to it; and (b) if these belong, other things must belong.

I take it that Aristotle is speaking of the same necessity referred to at the beginning of *Metaphysics* V.5. Here in the *De Somno* passage it is noteworthy that hypothetical necessity is explained using two different conditional assertions, both of them containing modal operators. The first part of the passage speaks of what is hypothetically necessary for existence:

> (a) If an animal (having its own nature) is to exist, then of necessity certain things must belong to it.

The context shows that the necessarily belonging thing which here lies nearest to Aristotle's mind is the waking state in animals. He has argued earlier in *De Somno* that waking and sleeping are contraries such that one of these two must be present to every animal; moreover, that an animal cannot continue always sleeping (454b9). This last assertion

follows from the assertion that animals have *per se* a faculty of sense perception.[42] His reasoning is, that for sense perception to be actualized fully while an animal sleeps is impossible, since sleep just is a natural incapacity to perceive due to exhalations affecting the primary sense organ. But no true faculty can remain always unactualized;[43] consequently the waking state, which involves the exercise of sense perception, belongs necessarily to a normal animal in virtue of what it is. Sense perception is thus hypothetically necessary for the existence of an animal inasmuch as it belongs by definition. From here it is a short step to treating the claim: 'A (true) animal may exist without sense perception' as

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[42] cf. *DA* III.12; *De Sensu* 436b10-12; *De Somno* 454b24-5. *GA* 736a30 states that an animal is so-called in virtue of the sensitive part of its soul. For a further discussion of sleep see *GA* 778b20-779a26.

[43] With this Aristotelian dictum compare *De Caelo* I.12, where it is argued that any capacity must be actualized over infinite time. That an individual animal has such a faculty insofar as it essentially resembles a paradigm of its species is a truth which it is self-contradictory to deny. (Compare what *An. Post.* 75b33ff says about predicates holding 'insofar as they are of such-and-such a thing'.) This is not to say that accidental factors cannot interfere to some degree with the essential features. For example, a defective animal could be born asleep and remain so for life. But, as Aristotle says about the sphericity of the earth, '...it is right to call anything that which nature intends it to be, and which belongs to it, rather than that which it is by compulsion and contrary to nature.' (*Cael.* 297b21-23) Of course, if the interference is too great there may be destruction of the substance.

In a nutshell: 1) Not everything exactly matches a species paradigm, though it must be close enough to be classified as a member; 2) Insofar as it is a member it has the species characteristics. To deny this is necessary to avoid contradiction. 3) If it doesn't match exactly, this will be due to accidental factors; and 4) Science takes no account of the accidental.

self-contradictory.

The other main point of the *De Somno* passage in its context is to show how sleep is hypothetically necessary for the good of animals. Thus the second part of the quoted passage runs:

> (b) If certain things necessarily belong to an animal, then other things must belong.

The argument for the hypothetical necessity of sleep is made explicit in *De Somno* Chapters 1 and 2: All organs having a function lose power 'when they work beyond the time for which they can work' (454a26-7). Rest is required to refresh the functioning member. Sense perception is the function of some part, which part must rest at certain times. This rest is sleep, and so sleep is necessary if perceptual activity is to continue. When Aristotle is explaining why animals sleep he tells us it is for the sake of waking activity, and when he explains why there is waking activity he tells us that an animal is by definition such as to engage in this activity (454b24-7).

It appears, then, that sleep is for the best inasmuch as the exercise of sense-perception or thought is the goal for all beings to which either of these pertains (455b22ff). The pasage cited refers to certain natural necessities -- including that of sleep for health -- and seemingly in addition to hypothetical necessities which follow by entailment. There can no question but that parts of a thing's essence are treated as hypothetically necessary for

the thing. Differentia of a species, which clearly enter into its essence, are sometimes explained by showing how they are hypothetically necessary.[44] Regarding what is assumed as *given* in an Aristotelian teleological explanation -- what is assumed as part of the goal or as background -- Richard Sorabji notes that Aristotle may take for granted a variety of characteristics. The list Sorabji draws up of what can count as given includes (i) parts of the body and their shapes, (ii) activities, including bodily functions, (iii) the way of life, e.g. feeding habits, (iv) psychological character.[45] For the purposes of teleological explanation Aristotle is willing to take as granted not only essential characteristics, i.e. genus and differentia, but also many of the so-called *per se* accidentals, which follow from the essence; though it is not always clear how to tell the accidental from the essential.[46]

Before returning to *Metaphysics* V there is another point to be made. It is that things which are or come to be by art, as well as some that are or come to be by nature, may be hypothetically necessary. Textual justification for this is to be found, e.g. at 639b23-30 and 642a7-13. In the former passage the example of a house is given for the realization of which it is hypothetically necessary that

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[44] For example, lungs are necessary in sanguineous animals in order to temper the heat of the body, and also a part of the *ousia* of those animals having them (*PA* III.6).
[45] See Sorabji Ch. 10, p. 156.
[46] A *per se* incidental mentioned by Kullmann (pp. 321-2) is the two-footedness of birds, which follows from their essential ability to fly and the fact that no sanguineous animal has more than four points of motion (693b5ff).

certain other things be produced and set in motion (cf.337b14-27). (We need not stop to inquire whether it is the house itself or its coming to be that is posited as an end, nor whether it is movements of a certain type or physical things of a certain type or both which are what is asserted to be necessary.) In the latter passage (642a7-13), along with the example of food for animals the case of a functioning axe is introduced in order to illustrate hypothetical necessity. Two things are held to be necessary if an axe is to perform its *ergon* of splitting wood: first, the axe must be hard; and second, if it is to be hard enough to split wood it must be made of bronze or iron. Here no clear distinction is drawn between existence and lesser goods. The goal, or good, is that the tool will realize its function; what is said to be necessary is that the tool have such and such a character and be made out of such and such material. In connection with a similar object, a saw, Aristotle speculates at the end of *Physics* II.9 whether the object's material is included in its definition. If so, he says, the necessary will be present in the definition as well. Perhaps the definition he has in mind is 'toothed iron object for dividing'; then iron is both hypothetically necessary and part of the essence.

Compulsion

Taking up again the discussion of *Metaphysics* V.5, we may note that Aristotle does not commit himself as to

whether being freed of evil can count as a special instance of good either existing or coming to be. The fact that he gives one illustration of each perhaps suggests that he thought not.[47] In either case he proceeds directly to a second way in which necessity is asserted, introduced as follows:

> We call the necessary...the compulsory and compulsion [*bia*]; i.e. that which impedes and hinders contrary to impulse [*hormē*] and choice. For the compulsory is called necessary; that is why the necessary is painful, as Evenus says: 'For every necessary thing is ever irksome'. And compulsion is a form of necessity, as Sophocles says: 'Compulsion makes this action a necessity' [*Elektra* 256]. And necessity is held to be something that cannot be persuaded -- and rightly, for it is contrary to the movement which accords with choice and with reasoning.
>
> (1015a27-34)

Aristotle seems to be speaking here in the first instance of actions and of things that happen to agents. The sorts of circumstance in which people can be held to have acted under compulsion are discussed at length in other passages, including *Eudemian Ethics* II.8, *Rhetoric* I.10, and

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[47] But see *Rhetoric* 1369b24ff, where escape from evil and the trading of greater evil for less are counted as goods.

Nicomachean Ethics III.1. One type of example which fits is that of a person who does something as the result of being threatened (cf. 1225a2ff). On a natural interpretation this would fall under the heading of hypothetical necessity, since performing the action is the only way of avoiding some evil. Aristotle, however, nowhere mentions the overlap of hypothetical necessity and compulsion. There is a somewhat different type of case in which animals, and objects too, can be said to have been compelled. If a lump of earth were thrown upward or an animal so fettered that it was just unable to move Aristotle would say that the earth had been forced to move up and the animal to remain still (cf. 254b15-22; 301b17-19; 1224a15ff). And cases like these do not seem, at least on the face of it, to be cases of hypothetical necessity, since it is not easy to specify an end for which the necessary movement or state is asserted to be necessary. The fact that inanimate things are sometimes held by Aristotle to be altered, locally moved, generated or destroyed by *bia* (force, violence, compulsion) also means that we need not restrict the compulsion varieties of necessity to the realm of agents. For example, at *Posterior Analytics* 94b37-95a3 we read:

> Necessity is twofold: one, in accordance with nature and impulse; the other by compulsion [*bia*] and contrary to impulse -- e.g. a stone travels both upwards and downwards by necessity, but not because of

the same necessity.

Postponing the question of what necessity 'in accordance with nature' might be, we can gather that the stone's travelling in an unnatural way must be due to an external compelling force. *Bia* has been spoken of earlier; its identification as a source of necessity is common in Aristotle's works.[48] I will not dwell on it except to repeat that the theory of compulsion is introduced to explain movements which cannot be due to the moving thing's own nature -- an element's motion away from its natural place, for instance (e.g. 253b33; 300a28). Being unnatural, forced motion is always asserted of a thing accidentally, and its origin is external to the patient, or in it *qua* other (cf. 301b17ff). Natural is prior to unnatural motion in definition, and further, Aristotle seems to believe that any forced local motion will be eventually found to depend on a natural local motion, if the explanatory chain is traced far enough back. Sublunary change in general depends on the natural motions of the heavens for its existence (*Meteor.* 339a28; *GA* 777b31. cf. 194b13; 1071a13). Further reason for believing in an eventual natural motion comes from *Physics* 294b30-295a9. There he argues that there can be neither constrained motion nor rest without natural motion or rest (cf. 215a1ff). We know from other texts that the accidental is never the *aitia* of the *per se* (e.g. 198a7ff cf. 1065b2); also that Aristotle thinks unnatural motion cannot be

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[48] Here are some of the clearest references: 369a20; 1026b30; 1072b12; 1224a15; 1368b35.

eternal (e.g. 269b6-10; 286a17; 296a32f; 301a6f). From these claims, together with the claim that whatever is constrained must be constrained by the *dunamis* of something else, it follows that any constrained local motion eventually requires a natural motion as its *aitia* which does not in turn have a prior, unnatural *aitia*. A similar argument is given for rest, at the beginning of *De Caelo* III.2: if a thing at rest is constrained, something must be hindering it. But there cannot be an infinite series of unnatural constraints; so there must be things which have a natural place of rest. All this is a considerable extension of what Aristotle says in *Metaphysics* V.5 about necessity due to compulsion, but it makes up an important part of his account of necessity in the natural world.

That Which Cannot Be Otherwise

From the fact that the exercise of a *dunamis* may constrain the behaviour of another thing, it does not, of course, follow that the constrainer acts out of a necessity of any sort. Besides, Aristotle believes that many changes in the sublunary realm are natural, and hence not constrained, and that in the heavens there is no constraint at all. Let us therefore turn to the last type of necessity discussed in *Metaphysics* V.5, from which, Aristotle says, all the others are somehow derived. At 1015a34-35 he characterizes it as 'that which cannot be otherwise'; elsewhere when wishing to contrast what cannot be otherwise

with both hypothetical necessity and that of the compulsion type, he calls it absolute, unqualified, or strict necessity (*haplōs*: e.g. 1072b12; 639b22f). In our passage he shows briefly that things necessary in the first ways mentioned cannot be otherwise. With regard to the compulsory he says that the compelling force is such that we cannot do other than act or be acted on in the compulsory way; and with regard to the (hypothetically necessary) contributing factors to the good, or to life and being he points out that the case is similar and the thing cannot be otherwise. The latter part of the relevant text reads:

> And similarly as regards the contributing factors [*sunaitia*] of life and of good, when in the one case good, in the other life and being, are not possible without certain things, these are necessary and this *aitia* is a kind of necessity.
>
> 1015b4-7

The *aitia* he speaks of here as a kind of necessity and which is associated with the contributing explanatory factors at certain other passages seems to be identified with or said to be in the matter (cf. e.g. 200a13-14; 642a1,13-17).

Aristotle now states that strict demonstration is a necessary thing. The fact that he singles out demonstrative syllogisms, as opposed to syllogisms generally, suggests that he is referring to the necessity of a scientific conclusion rather than the necessity of a deductive

inference.[49] The *aitiai* of its necessity are stated to be its premisses, that is, the impossibility of their being otherwise. At *Posterior Analytics* I.8 he seems to argue that a premiss is necessary only if it holds at all times; and further, that a premiss it holds only at those times during which its subject exists. In his logic, universal propositions have existential import, so he wants to say that if P holds of all S, then there must at all times be S, and P must always hold of it. Aristotle assumes that a thing is perishable if and only if at some time it perishes.[50] He draws the consequence that there can strictly (*haplōs*) be no demonstration, and no knowledge, of perishable things (75b21ff). Since all substances in the sublunary world are perishable, this has caused his interpreters worries about what he takes the scope of science to be. Sometimes (e.g.

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[49] He may be referring to both together. On necessity in the syllogistic, see Ch. 2 of Patzig, second edition. Patzig discusses at length Aristotle's attempt to make out a distinction between (a) the simple or absolute necessity of some propositions; and (b) the relative necessity associated with deduction. Patzig's view is that Aristotle mistakenly believes there are two types of necessity (absolute and relative) which both apply the conclusion of a demonstration; whereas in fact (Patzig claims) Aristotle is dealing with one type of necessity ('logical' or 'by definition') which is applied to two types of proposition, viz. universal propositions about predicates or terms on the one hand (syllogisms), and universal propositions about individuals on the other (the necessary conclusions of demonstrations, for example). In my view, Patzig's discussion is needlessly complicated by his own failure to distinguish between two questions: (a) Does Aristotle confuse *de re* and *de dicto* necessity? and (b) Does Aristotle confuse *Nec(If A then B)* with *(If A then Nec B)*? Barnes' English translation makes some emendations in this connection. Compare also Patzig's Preface to the Second Edition.

[50] See especially *De Caelo* I.12.

An. Post I.27,30; II.12) Aristotle qualifies this by talking as though there can be demonstrations in which the middle term holds for the most part only, a concession to his desire to grant knowledge of sublunary species given his belief in contingency below the moon.

He goes on to state in *Metaphysics* V.5 that the necessary in the primary and strict sense is the *haplôs* -- the unqualified or simple. The argument is that what is strictly necessary does not admit of more states than one; Aristotle wants to include all possible times as well as all possibilities at some given time. Thus he is ruling out any possibility of *change*, as well as the possibility of otherness at some given time; hence his mention of eternity (1015b15). What does not admit of more than one state is simple or unqualified, so the strictly and primarily necessary is simple. Aristotle is clearly thinking of the first mover, God, or first movers, if there are more than one (cf. *Metaph.* XII.7; 258b10, 259a7). He also has the heavenly bodies in mind, since although they are in motion, their movements are eternal and simple, and the bodies themselves are unchangeable (cf. *Cael.* II.6). This, and his earlier remark at 1015b10 'they are the origin of necessity in other things' confirms that compulsion and hypothetical necessity are not only posterior to the third type of necessity in formula, but that there is causal posteriority as well. He concludes by saying that nothing contrary to their nature attaches to the eternal and unmovable objects.

It is taken for granted by him that there is not the faintest trace of accident or chance in the heavens (cf. 196b1; 641b23).

If there is natural contingency, therefore, it will be in the realm of things under the moon. In the final chapter I will speculate a little further about what we should take a claim of natural necessity to entail, and about Aristotle's theories concerning such necessity.

B. Natural Necessity

Let us take some time to establish on our own behalf a working definition of natural necessity. Suppose someone on a bridge drops a pebble which, falling at the usual velocity, narrowly misses a passing philosopher. He wonders whether it could have hit him, say. More precisely, let us imagine he wonders whether once dropped it was necessary for the stone to travel just the path it did, at just the speed it had. We must be careful to distinguish a number of problems here.

Some Clarifications

First, it should be made clear that the issue is not, or at least not first and foremost, about the necessity of the past. We are not worried about whether it is possible for something now to change an event which has already occurred. This is perhaps obvious, but a second point is less so: we will take it as granted that the stone had the characteristics it did when it was released, even if it could have changed afterward. The idea is to avoid any distracting suggestion that perhaps *the very stone that was dropped* (here the speaker points) could all along have been differently constituted. In fact, we are only incidentally concerned with this particular stone, and we assume that another of similar size and shape and weight would have served to pose the same question of necessity. Taking it for granted that the pebble was as it was when dropped helps to

free us from inquiring into the criteria of identity for stones, a difficult subject, and thus means that we will not need to ask whether or when our stone could have had a different causal history while remaining the same thing. For similar reasons, just when a change in it after it was dropped would have given us a different stone is likewise a problem that can be ignored: answering it is not requisite for determining whether it could have changed (be it essentially or accidentally) after being released so as to alter its path or speed, which *is* part of our question. Given, then, that our stone had these features, could it or a relevently similar stone have behaved differently?

There is another interpretation of the question 'Could the stone have done otherwise?' that should be distinguished from the interpretation I would have us put on it. We may as well call it the *epistemic* interpretation. On this reading to ask whether an object necessarily travelled downward is to ask whether it is certain to have done so. We can imagine someone, when asked if he is sure, saying 'It *must* have gone in that direction; he told me so'. What is asserted on the epistemic reading is that the epistemic resources at hand -- the evidence, if you like, whether present or available, either to a community or to an individual -- does not allow any other, competing claim to remain in the field as a possibility.[51] The epistemic use is closely related to (and

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[51] This is only one sense of 'certain', though an important one. Compare epistemic and non-epistemic uses of 'possible', sometimes distinguished by the expressions 'possible that' and 'possible for' respectively. That it is not possible

perhaps in part rests upon) another: the necessity of a conclusion's following given appropriate premisses, the necessity of what is asserted given that it is entailed. A consequence, or the necessity of validly drawing it, is an inability to accept a contradictory conclusion if the laws of logic are to be observed. Inferential necessity is related to epistemic necessity in this way among others: if the premisses are known, then what follows will be inferentially necessary and will sometimes as a result be epistemically necessary. Logic and the premisses may be enough for the conclusion to be certain for someone.

So far, we have a question and some unwanted construals of it. What we want is an interpretation which allows us to better understand the assertion of natural necessity. Let us consider an example of inferential necessity that is directly relevant to worries about natural necessity: given some relatively simple accidental generalizations about the way actual physical objects move, and given an appropriate description of some such object and its circumstances -- say a stone that is being dropped from a bridge -- one may be able to draw a consequence about the behavior of the object. That is, it may be possible to validly derive a conclusion which describes what the stone will do. If someone then

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[51](cont'd) *that* a rock has shot sideways does not entail that it is not possible *for* it to have done so. Let N=Necessary, P=Possible generally, C=Certain and EP=Epistemically Possible. Then Nx iff ¬P¬x, and Cx iff ¬EP¬x. I believe there is a close connection between necessity in general and certainty in particular, but for now it is simply important to note that natural necessity is not the same as epistemic necessity.

asks: 'Could the stone have done otherwise?' and one takes him to be questioning the necessity of the inference, the answer will be 'No'. Granted the generalizations and the description of the object in its circumstances, if the conclusion follows the prediction of behavior must be accepted if consistency is to be maintained and the behavior truly described. Another way to put the same point is that when one says the rock must travel such-and-such a path what one might mean is that given the laws of logic it must for the course of nature to remain constant, i.e. for the simple generalizations about object movement to be preserved. Notice this does not yet require that the generalizations about behavior support counter-factual reasoning about what the rock would have done under merely possible circumstances. So far, it might still be a simple matter of fact that all actual stones released under the circumstances travel downward in this way. Similarly, given that all objects of a certain type -- call it the 'widget-type' -- just happen to be on a particular table one might ask 'If Widget #11 is a widget, must it be on the table?'. When the question is construed as being about inferential necessity ('Must it follow?') or epistemic necessity ('Must it be, if what we know is true?'), the answer will be 'Yes'. Epistemic and inferential ways of construing the question are distinct from the reading that asks about natural necessity. They are, however, perfectly plausible interpretations in some contexts, and might be distracting to us if not recognized

for what they are.

An Account

When does the question of natural necessity arise? It does not arise until the question of capacities or abilities is raised. If 'ability' is the nominalization of 'can', then supposing that something is necessary if and only if it cannot be otherwise the claim can scarcely be denied. But to say that a claim of natural necessity raises a question of abilities does not yet do enough to distinguish natural from inferential necessity, since if an inference is necessary there will also be something capable of grounding, or able to support, that inference. All necessity carries with it the notion of ability, but in order to show how natural necessity differs from the necessity of inference we must say more about the ability involved. I should make it clear that although ordinary usage sometimes reserves 'ability' for the abilities of conscious agents I am talking about ability in the broadest use of the term, such that something is able if and only if it is in some way *adequate*. If the interchangeable use of these expressions seems at first glance slightly awkward, it has the advantage of drawing attention to a certain sameness of meaning that is not always remarked. Of course it does not make sense to speak of ability or adequacy without saying what the able thing *can do*, and what the adequate thing is adequate *for*. Since a fixed vocabulary is desirable, let us call the thing or

things said to be adequate the *subject* or *subject range*, and the thing it is adequate or inadequate for, the *objective*. There is one more point that is worth mentioning here. We say a thing is adequate for some objective either when it can all by itself accomplish the objective or when it can play a part together with other factors in accomplishing that objective. For example, the High Level bridge is able to hold up a locomotive. It plays a part together with factors like a solid river-bottom. Or again, a premiss is able to ground a conclusion when it is joined with other premisses. Let us say in cases of this kind that the subject is adequate *in its own way* for the objective, reserving the simple expression 'adequate' for complete adequacy.

Now we can formulate a rough working account of natural necessity. Natural necessity is often asserted relative to a given background of factors which are assumed to exist and taken as granted. To assert of some x, an event or state or process, that it is naturally necessary is to assert that no subject s is adequate in its own way, together with the given factors, to bring about or cause an alternative to x. In other words no subject range r which includes both s and the background factors can by itself cause not-x. The introduction of causation distinguishes natural from inferential necessity.[52]

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[52] A simplified corresponding account of natural possibility is: for some subject, A is naturally possible iff the subject can, or is adequate to, cause it. If every element in the subject range actually exists, then A will exist as well. I am taking it that to say 'X, or X together with a range of other things is adequate for Y' is not yet to

The schema is quite abstract, and not altogether clear, but some of the intuitions behind it are familiar. We think that something is naturally necessary if and only if nothing can cause it to be otherwise.[53] Here is a typical example having factors which we assume as given: a tree cannot reach a height greater than twenty feet *given the prevailing climate*. (The soil is not in its own way adequate.) Its shortness is thus said to be necessary. These usually tacit conditions can always be built into what I have called the subject range. That is, we can still say simply that the subject range is not adequate, meaning to include the prevailing climate. Of course, some parts of the subject range will be of greater interest to us than others and hence will tend to be thought of as 'the subject', just as some parts of a sufficient cause generally will be of greater interest to us and will thus tend to be called 'the cause'. The limiting case of necessity, if there is such a thing, is that case in which nothing is taken as granted: Cosmic Necessity. In this scenario there is just nothing at

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[52](cont'd) commit oneself to saying (i.e. not yet to entail that) each part of the subject range exists.
A little more concisely: let r=Subject range, N=Necessary, P=Possible, A=Adequate to cause. Then,
(1) For any r, Px iff rAx
(2) For any r, Nx iff ¬(rA¬x)
It follows that for any r, Nx iff ¬P¬x
I will not claim that this is the only or best analysis of the notions of necessity and possibility, but it has seemed to me a useful schema to work with.

[53] Two pressing questions (among others) that cannot be dealt with here are
1) What difference does the shift from 'can' to 'could' make?
2) What is the relation between necessity and dependence?

all that can bring about or cause not-x, period. But ordinarily we are, or at least take ourselves to be, talking about more modest forms of necessity. We want to know whether it is possible for our tractors to move that rock blocking the road, for example -- whether their pushing is adequate in its way (together with the force of gravity and such other unnamed factors as may be operative) to bring about motion. The question of determinism is not generally thought to be raised in these cases, and until it is shown how and whether these humble assertions of necessity really involve Cosmic Necessity it is best not to automatically assume they do.

This leads me to say what I think the virtues are of talking about natural necessity in the above way. The schema I have offered is flexible enough to accomodate some ordinary ways we speak, and does not beg questions about causal determinism. For example, we ordinarily think that it is necessary for us to die at some time or other, our will and desire to the contrary notwithstanding. Nonetheless, we believe ourselves capable of taking steps to avoid its happening *today*. Whether or not we are right in either case, we can express these claims using the language of adequacy, or of joint-adequacy under given circumstances, for causing effects. Again, we may wish to distinguish between claims about the necessity of some event given the laws of nature that there are, and the necessity of the laws themselves. The account allows us to pose the problem, and by pointing

us towards questions about what the subjects, objectives and background factors are, gives direction to inquiry. Finally, it emphasizes structural similarities between talk about what conscious agents can do and talk about other instances of causal ability, that of bridges to support heavy loads, for example. For such reasons as these it seems to me a helpful and certainly non-trivial starting point. If it is not exactly right, it cannot be far wrong.

Returning to our initial illustration, we can give it an Aristotelian flavor by supposing that the stone has an impulse to realize its form. But perhaps there was an air mass present adequate in its own way (though some other factor was absent) to form a wind, in turn adequate together with other factors to hinder and deflect the stone. Then we would be inclined to say that the stone could have done other than fall as it did. The air mass, as we might put it, had an unrealized potential. Because the stone would not be a stone, however, if it did not have this impulse, nothing is able to prevent it from having its own natural potential and impulse as long as it exists. To destroy the impulse and *archē* would be to destroy the stone.

Using our account of natural necessity we can construct an account of natural hypothetical necessity. To say that a thing X is naturally necessary for some Y, is to say that a given subject which does not include X is not adequate to cause Y's existence. Food is naturally necessary for human life to continue, if and only if food is part of a subject

range adequate to cause human life, and there is nothing in addition to food which, together with the rest of the subject range, is adequate to cause life. This is a very difficult thing to state clearly and understand; indeed, to understand natural necessity with perfect precision would be to understand the question of causal determinism as well as the nature of hypothetical necessity. It will not be possible to explore the subject thoroughly here, and one more example must suffice. Suppose there is a river flowing down to the sea. Someone says: 'Although this river actually takes route A instead of route B, there is no necessity for it to do so in order to reach its goal, since route B is also a possibility'. What shall we take him to be claiming? It is not being asserted absolutely that the river could naturally take route B, but that it could naturally take route B *to reach the sea*. The two claims differ in that the former asserts adequacy of a subject to bring about the taking of path B, whereas the latter asserts adequacy of taking B (together with other factors of a subject range) for reaching the sea. We must understand the denial of necessity as a claim that taking B instead of taking A is adequate, together with the given range of causal factors, to accomplish the end in view. Whether or not such claims are ever true, this or some similar way is the way we must take them in order to make good sense of the problem.

A Disputed Question

One of the more hotly contested questions in recent Aristotle scholarship is whether he takes all non-compulsory necessity in the world of sublunary generation to be hypothetical. On the affirmative side can be found, among others, D. M. Balme, W. Kullmann, A. Preus and H. Weiss. Those in disagreement include W. Charlton, J. M. Cooper, G. Fine, M. Nussbaum, and Richard Sorabji. One way of putting the question is to ask whether Aristotle holds that the coming-to-be of any particular thing under the moon is necessitated by causes, or whether all necessary individuals are only necessary given that some good will exist or be brought about. This question is narrower than the general question of whether Aristotle is a determinist, since some of his discussion of whether future events are determined centres, not on the inexorability of (certain, or all) causal sequences running their course, but on considerations like the law of the excluded middle.[54] Nevertheless, though not so broad as the problem of determinism, the problem of causal necessity in Aristotle is still a big one, and in subsequent pages I cannot hope to touch on all the issues.

One reason for the difficulty in understanding Aristotle's remarks about causal necessity has been discussed earlier: the complicated relationship between *aitiai* and causes. A second reason has also been mentioned. Although expressions for 'must' and 'of necessity' occur

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[54] I am thinking here, of course, of *De Int.* 9 and its discussion of the future sea-battle.

over and over again in the corpus, Aristotle seldom makes it clear precisely what is asserted to be necessary, nor exactly specifies the subject and object of the inability that is involved. Two further representative examples will be offered. At *De Caelo* 301a20ff Aristotle states that there are bodies with the natural capacities of weight and lightness, and he adds: 'Of necessity, we assert, they must move, and a moved thing which has no natural impetus cannot move either towards or away from the centre.' But whether the necessity for motion is the necessity of an argument's conclusion, or of some other necessary truth, or whether it is a form of natural necessity, or whether it is a metaphysical essentialist claim holding of each light or heavy thing -- none of these can be decided from the context. Trying to answer such questions using what Aristotle has given us is rather like trying to do watch repair with carpenter's tools: the tools are unsuitable. I do not mean to sound ungrateful to Aristotle. Hammer and chisel are sometimes just what is needed. Only, they should not be used for the wrong job.

A second example is taken from Aristotle's biological writings, where an apparent contrast between hypothetical and non-hypothetical necessity in nature is frequently drawn.[55] In *De Partibus Animalium* IV.9 Aristotle is explaining why certain Cephalopoda have tentacles and suckers. He states that these appendages are present so that

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[55] The example is mentioned by Kullmann. See pp. 329-38, esp. 338.

their owners can propel themselves or remain moored, catch prey at a distance and bring it to the mouth, and can employ them as hands for offense and defence and for other uses (685a28-b12). He then says that the suckers are set in a double row in all the Cephalopeda except in one kind of octopus, which, as it is long and slim by nature, has only one row.

> For a narrow space cannot possibly admit of more than a single row. This exeptional character, then, belongs to them, not because it is the most advantageous arrangement, but necessarily because of the proper account [*idion logon*] of its being. (685b12-16)

Clearly the point of the quoted passage is to explain why an octopus of this last type has one row of suckers rather than two. One row is not so good an arrangement, or at least no better an arrangement, than two rows if two can be conveniently arranged. Having one rather than two is therefore not to be explained by hypothetical necessity. However, having one rather than no rows at all *can* be explained as being hypothetically necessary on Aristotle's view: the suckers exist by a natural hypothetical necessity if they play an indispensible causal role in keeping their particular possessors alive; their existence can also be *inferred* (in virtue of the private account of their owner's being) on the hypothesis that a well-formed octopus of this

type is to continue existing. Thus Aristotle would wish to claim that there will be a a hypothetical necessity both logical and natural that *a* row of suckers be present, if there are to be creatures of this type. But Aristotle actually seems to be appealing to other sorts of necessity in the quoted text, for he says there that a narrow space cannot possibly admit of more than one row. This (dealing with relative sizes) may be either a necessity of geometry, or a natural necessity concerning the inability of a small tentacle to function with too many suckers; or both. Again, it is possible that he is also claiming there is a causal necessity for certain temporally prior creatures (or other factors) to produce (barring hindrance) a later substance with but one row of suckers. In other words, not that if a future octopus will be then one prior row of suckers must be; rather that if a prior octopus (or other material or agent factors) exist now, then a single row of suckers will be caused of necessity under appropriate circumstances. I do not say that my list exhausts the types of necessity that Aristotle might wish to assert concerning the small-armed octopus. It should in any event be realized that the necessity operator can do a number of different jobs in such cases, and that Aristotle is seldom at pains to say which purposes it is serving.

The Balme Interpretation

In connection with Aristotle's writings on necessity in nature David Balme's interpretations are somewhat representative, and because a good deal of recent discussion has taken its start from his lucid exegesis, I would like to summarize some of what he says.[56]

Balme thinks Aristotle is committed to the view that all things that come to be are if necessary only hypothetically necessary (p.80).[57] He grants that Aristotle does not precisely say this, but he holds that it must be the Aristotelian view '...if hypothetical necessity and teleology are more than "*als ob*" explanations -- as he perfectly clearly believes.' (p.80) Grant that all hypothetical necessity applies to things that come to be for an end. It cannot be, according to Balme, that an event occurs both (a) for an end, and (b) as an absolutely necessary result of (temporally prior) material/agent factors like heat and cold. He asks,

> If the action of heat is absolutely necessitant, what meaning is left for (a)? We should have to suppose that a ghost in the machine switches the heat on and off, but in that case what becomes of absolute necessity?' (p.79)

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[56] I rely chiefly on his Clarendon *Commentary on De Partibus Animalium I and De Generatione Animalium I*, esp. pp. 76-84, 93-98.

[57] He actually says 'all things are always and only'; but the weaker claim will do, and is a more plausible reading of Aristotle.

Since all things with natures come to be for the sake of ends on Aristotle's theory, and since this would provide only an 'as if for an end' explanation if they were absolutely necessitated in the other way, and since Aristotle does not believe in mere 'as if' explanations, he must deny that prior material/agent factors produce events of (absolute) causal necessity. This is the nub of Balme's argument.[58]

There are quite a number of passages in the biological works which seem to *contrast* material/agent necessity with hypothetical necessity.[59] Balme is, of course, aware of them, and has an explanation. He cites as an example *De Generatione Animalium* V 778a16-b19, where Aristotle says that the eye is for the sake of something and is hypothetically necessary, but that its being blue is not for the sake of anything and is necessary because of natural action and reaction during its coming into being. Balme suggests that what is intended here is only a contrast between *ultimate* and *proximate* hypothetical necessity. Blueness is accidental to eyes; therefore the blueness of its matter is not for the sake of an eye. And it cannot be hypothetically necessary for the eye's existence. Now, there are parts to an eye, and these parts are (potentially) matter-form complexes in their own right. Further, the matter of a *part* of an eye is in its turn (potentially) a

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[58] Compare J. Barnes' notes on *An. Post.* 94b27-37.
[59] For a great many references, see Sorabji, Ch.9, notes 15,17.

substance composed of matter and form. The matter of the lower stages, says Balme, is at most ultimately, not proximately for the sake of, and necessary for, the eyes (p.81). What is hypothetically necessary for a lower stage complex is not always for the sake of a higher stage complex. To shift examples along with Balme, an animal may require limbs for walking, which require a joint and rigid lever made of flesh and bone. Bone is brittle; the brittleness, however, is not proximately necessary for animals, (being accidental) but is only ultimately necessary. Again, an animal may require plants for food, and a plant may require some parts, like thorns and wood, which are indigestible. Thorns are accidental to food, and are even a liability, so they are not proximately hypothetically necessary for food, but only ultimately. Balme's suggestion is that Aristotle found it natural to call ultimately necessary things *necessary on account of the matter*, without thereby committing himself to any absolute necessity in the realm of particular becoming. Matter is always capable of being otherwise, so that in the case of eyes matter which is potentially blue may turn grey, yellow or dark. Thus, on Balme's reading of the 'blue eye' passage, a kind of causal contingency always creeps in at the level of matter. An eye requires parts which in turn require matter that may in fact be blue but which could be other. This contingency is not just our uncertainty about the way things work, but is actually present in the world, in part because fresh

beginnings of motion are always occurring (p.82).

Objection to Balme

How much of Balme's interpretation is accurate? It should be remarked at once that his explanation does not show the blueness of eyes to be hypothetically necessary. If matter at some level could be other than blue then blue matter is not hypothetically necessary, even ultimately, for an eye. (It may still be indirectly *for the sake of* the eye.) Nor is it obvious how, in the case of animals, having brittle limbs is hypothetically necessary, directly or otherwise. Suppose that to say bone is brittle is to utter a necessary truth. Then the question arises why *this* type of substance rather than some other, is required for limbs. If the presence of brittle rather than non-brittle matter in limbs is not naturally necessary in a non-hypothetical way, then brittleness in animal limbs is not naturally hypothetically necessary, proximately or ultimately. Just the same holds for indigestible plants: unless there is a natural, non-hypothetical necessity that death comes to non-eaters of thorny things, there is no hypothetical necessity that if there be food there will be inedible parts to it. To put the matter shortly, hypothetical necessity in these passages, if not inferential, will involve natural necessity simpliciter. If there is contingency in the causal order there will be natural hypothetical contingency. To assert natural hypothetical necessity of a thing is to

assert that nothing is able to replace it in causing some objective. But this is just to say that the objective's absence taken together with the necessary thing's absence is simply necessary. If thorny food is hypothetically necessary for life, then death is necessary in the absence of such food. Aristotle himself seems in a general way to have been thinking along similar lines when he said in *Metaphysics* V.5 that hypothetical necesity was derived from the unqualified sort. Perhaps Balme has been misled in part by the easy move from 'X is for the sake of Y' to 'X is hypothetically necessary for Y', a move which works if X follows from Y's definition, but fails if any alternatives to X are adequate to do the same causal work. He appears to use the two locutions interchangeably. In any event, he just cannot be right in saying that there is hypothetical natural necessity for Aristotle but none of a non-hypothetical sort. Aristotle is committed to assert both hypothetical and non-hypothetical necessity in sublunary generation, though his theory of natures as both movers and ends serves to obscure this, especially when taken together with his desire to explain *per se* accidentals like the blueness of some eyes. Nature as capacity cannot explain such traits if they are no part of the actual nature, and this demands that lower order capacities be invoked. Because they are not hindered by the higher ones, and because their actualization is more immediate, and because they are being contrasted with the realization of a much greater good (the

coming-to-be of an organism), it is easy for Aristotle to say that they are realized not for sake of the good, but of necessity. The shift from inferential to non-inferential necessity is easier at this level: fire uncontrolled has certain effects of necessity but, again, it is hard to say in any given explanation what sort of necessity is being spoken of.

Contingency

In pointing to claims elsewhere of contingency in nature, however, Balme justly emphasizes an important feature of Aristotle's thought. Though he says that an active non-rational capacity when it meets with a passive one in an appropriate way must be actualized (*Metaph.* IX.5), Aristotle will be found arguing (e.g. at *GC* II 337b3ff) that the coming-to-be of non-eternal particular things is not necessary. The problem has to do with how we treat the 'in an appropriate way' clause. It is intended to cover hindrances, and imperfections in the matter of the parties involved. These circumstances are, according to Aristotle's natural philosophy, an irreducible feature of the world. All natural and artificial agent capacities in the sublunary realm are subject to frustration either by imperfection in the matter on which they work or by motions which conflict with them (e.g. *GA* 778a4-9). The results are contrary to art or nature (cf. e.g. 770b9-27). It is this liability which explains why natural regularities under the moon are said by

Aristotle to hold 'for the most part' only.[60]

Something more must be said about capacities. To ascribe an Aristotelian capacity to a subject is not just to say that it, together with a range of other things, can bring about or cause some result. The claim is stronger than that. Suppose a man's little finger on a button, together with a range of other factors like dynamite, an electrical charge and so on can bring about the collapse of an old building. Aristotle would not say that his finger has the capacity to bring down buildings. One difference is that a corresponding capacity to be moved must be in a moved object, and Aristotle seems not to want to reduce this passive capacity by building it into the notion of an active mover. We might be inclined to say that once all the parts of the active cause have been stated there is nothing left to say except that the effect will result, but this is not Aristotelian. In particular, matter which is operated on by a capacity (either by an art or a nature) must have a corresponding capacity to receive the form, and if it does not, the form will be imperfectly realized and the result contrary to art or nature. Secondly, as I have tried to suggest, his doctrine of capacities makes tacit reference to a background of normal conditions.[61] These conditions are violated whenever the actualization of another capacity interferes. Consider the case of honey-water, for the most

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[60] See, e.g. 25b14; 32b4-13; 134a7-11; 727b29; 777a19-21. These references due to J. Barnes p.184.

[61] From a somewhat different angle, S. Waterlow discusses this in *Nature, Agency and Change* Ch. 1, Sections 34ff.

part useful for a patient in a fever (1027a23-24). It might be suggested that the exceptions to the universal rule can be taken into account by improving medical science, or by appealing to some other science which demonstrates using necessary premisses.[62] Aristotle seems to toy with this idea in places,[63] but he does not embrace it, and his arguments concerning contingency and spontaneity are not compatible with it. Hindrance due to the operation of other capacities cannot be fully explained, nor can imperfections in the matter. Real contingency does after all creep in.

How are we to understand this? Is not matter at one level of explanation just a form-matter complex at some lower level? Prime matter, at the very lowest level, can hardly be a source of contingency. So how can matter introduce contingency? Why, for example, isn't there a branch of science to tell us exactly how that substance which will in fact become the matter of a monster will resist nature? Aristotle's lame reply must be that *qua* matter there is no scientific understanding of it. There is no science of the way matter resists form; only a science of forms which takes it as granted that form will master

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[62] Ross in his Commentary makes this suggestion concerning the passage, and Joachim also endorses a similar claim in another context (See his *Introduction*, esp. xxvii-xxviii) Joachim allows that Aristotle 'hesitates', but he wrongly attributes the hesitation to Aristotle's anxiety to maintain man's freedom as an agent. In fact, Aristotle has much broader incentives -- e.g. allowing for spontaneous generation and the existence of monsters due to 'failure of the purposive effort' (199b4; cf. *Rhet.* 1369b4-5; *Phys.* II.4-6).

[63] See Sorabji, p.20; J. Barnes' notes on *An. Post.* I.8, which deals with demonstration of 'most part' conclusions.

matter. There is no moving *aitia* or natural capacity -- there are certainly no natural forms of monsters, he would say -- whose mention explains the failure of the capacity in question to realize itself. Further, what happens when contrary capacities conflict is not itself explicable by reference to a capacity.

These features of Aristotle's thought are exemplified by the discusion of accidents in *Metaphysics* VI.2-3. The argument turns on his definition of *aitia* in terms of explanation. He reasons that there are accidental conjunctions in nature: this is evident because there are conjunctions of a sort which are not usual, or such that the mention of one thing does not explain the existence of the other. For example, a housebuilder may happen to make a house that is hurtful to someone. Making a hurtful thing is accidental to a housebuilder because it is neither for the most part nor self-explanatory. Aristotle holds that of an accident there is only an accidental *aitia* (e.g. 1027a7-8; 1065a6-8); and because when explaining accidentally it is possible to mention an infinite number of factors -- there are infinitely many accidental features to a thing -- he concludes that of an accident (here, perhaps, the making of a hurtful thing *by a builder*) there is no definite *aitia* (*aoriston*: cf. *Metaph.* V.30; *Phys.* II.5). That is, there is no definite thing whose mention really explains the accident. Again, an *aitia* must be something whose mention is explanatory; mention of the housebuilder does not explain an

infinite number of accidental things; therefore the housebuilder does not produce them, at least 'not in an unqualified sense' (1027a5). Thus, what grounds Aristotle's claim that some things, namely accidents, have no true *aitiai* is the claim that the accidental is not subject to explanation. We might be inclined to say that whether a thing is accidental or not can depend on the way it is described, and then to ask whether each event, state or process has some non-accidental description. We would, or ought to, reply that a particular housebuilder plays a causal role in making life unpleasant for people, just as he does in piling up stones, even if it is not self-explanatory to say so. This is not the way Aristotle thinks. He calls non-linguistic things, not (or not only) descriptions, accidental. Of accidental things he says that some tend to be produced by alien capacities, but for others there is no determinate art or capacity.[64] His conclusion is that not everything will be of necessity, and he means to include individual events.

Closing Remarks

We have examined a number of aspects of Aristotle's explanatory framework. A sort of leitmotiv running throughout the inquiry has been his tendency to ignore or

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[64] 1027a5f. The text is somewhat uncertain here. He may be saying, not that some accidents are produced by alien capacities, but that there are capacities which produce other things. The latter reading would if anything strengthen my claim.

pass lightly over the distinction between causal and inferential relations. I have tried to point out some ways in which this tendency influenced or may have influenced his treatment of necessity in the natural order. The role that a theory of *capacities* plays in his science has been especially emphasized. To understand them properly is to understand certain relations between the four explanatory factors -- how formal, final, and moving factors can be identified, for example. Of course we have not exhausted our topic of cause and necessity in the Aristotelian philosophy; but perhaps enough has been done to introduce it. To say everything would be a great task indeed if these along with being and the good are, as I suppose, among the few really central preoccupations of his life's thought.

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